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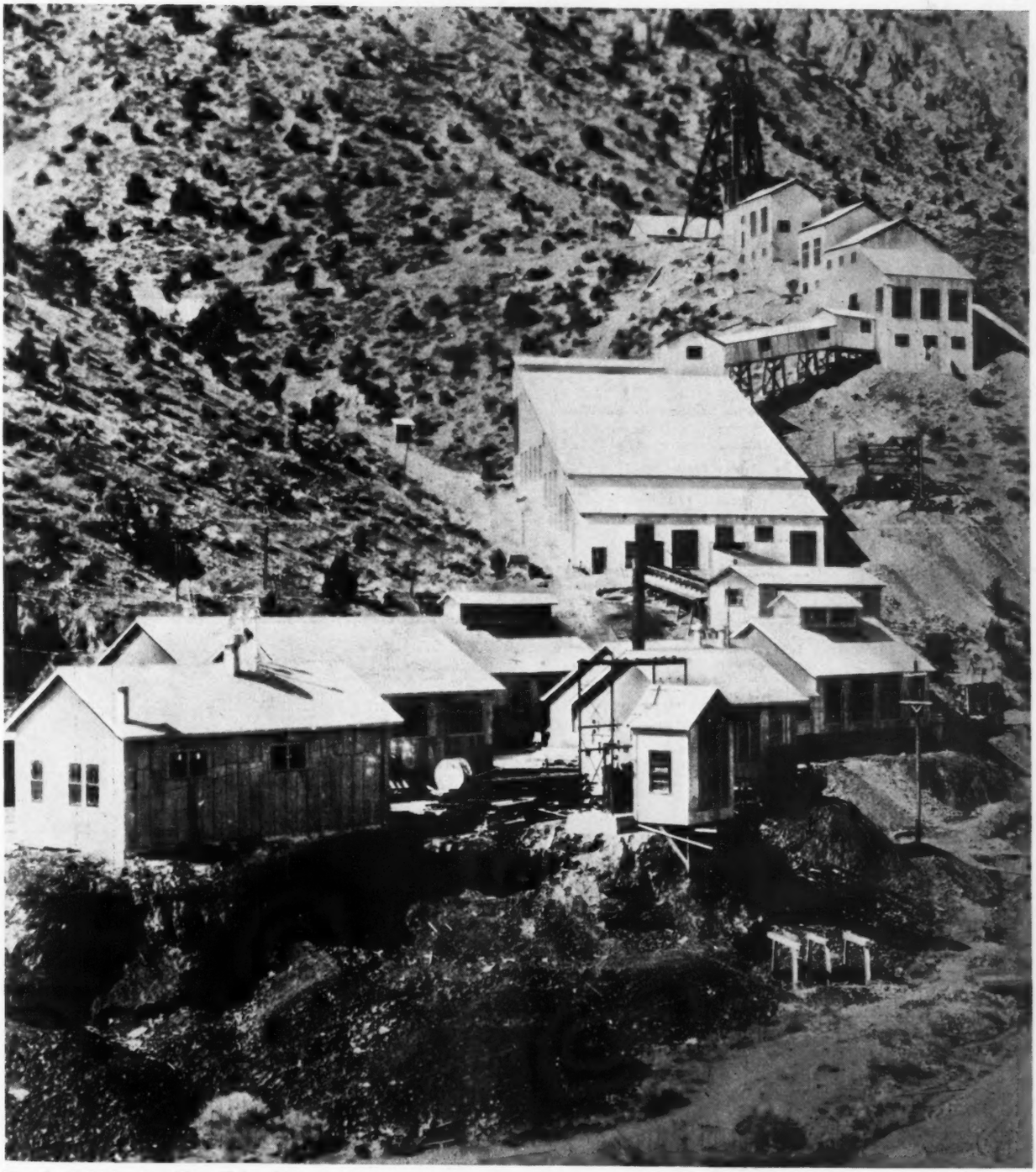

Treadwell Yukon's mill at Tybo, Nev.

April 7, 1930

R-1858

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ENGINEERING AND
MINING JOURNAL
A McGRAW-HILL PUBLICATION

A. W. ALLEN, *Editor*

Associate Editors
E. H. ROBIE, A. H. HUBBELL
New York
GEORGE J. YOUNG, San Francisco

Assistant Editors
W. N. P. REED, H. D. KEISER
S. D. STRAUSS
Market Editor: H. H. WANDERS
Publishing Director: H. W. CLARKE

Contents for April 7, 1930

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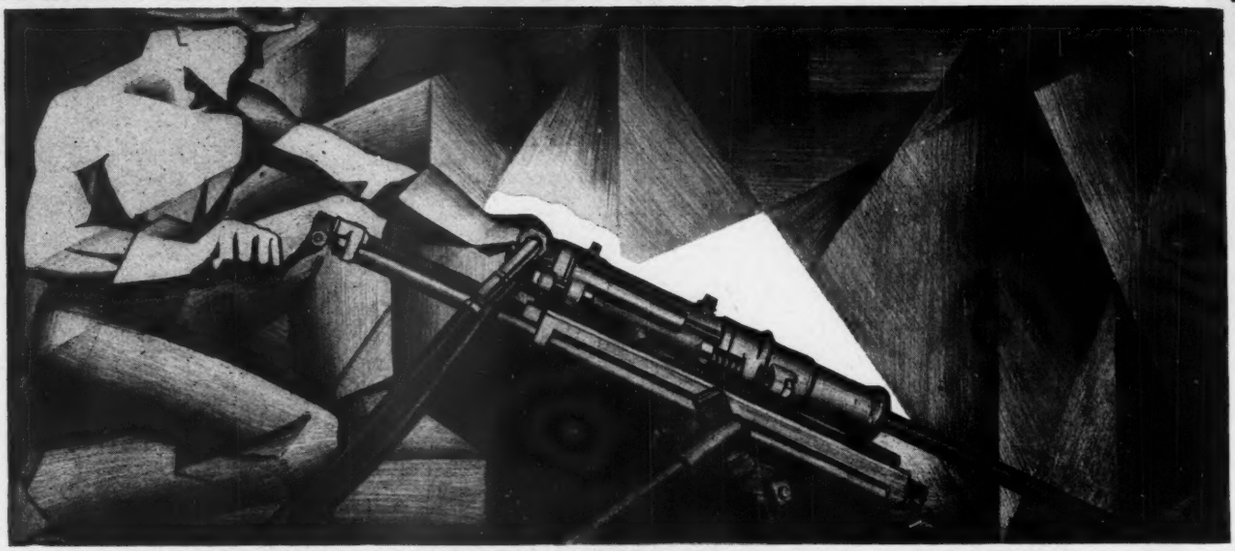

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ENGINEERING AND
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JOURNAL

A. W. ALLEN, *Editor*

VOLUME 129, NUMBER 7

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New York, April 7, 1930

Senate Asks the Silver Miner to Disregard the Facts

OUT WEST, where the drop in the prices of silver, lead, and zinc has seriously affected mining operations, the adoption of the Pittman tariff amendment, which levies a duty of thirty cents an ounce on imported silver, will probably cause expressions of satisfaction. Yet *Engineering and Mining Journal* gravely doubts whether the tariff will accomplish its avowed end, or whether, even if it did, such a heavy tax on the consumer would prove desirable.

Production of silver from United States silver mines has been less than thirteen million ounces annually for the last four years. In 1929, it was probably about ten million ounces, worth little more than five million dollars. Not more than three thousand men can have been employed in mines producing only silver. The thousands of silver miners suddenly unemployed by the most recent drop in the price, of whom Senator Pittman has made frequent mention in advocating his amendment, are at least partly figments of his imagination. Such mines as have closed or have curtailed production in Western camps have done so largely because of the market conditions of lead, zinc, and copper—not silver. Mines that have closed in the Tonopah district of Nevada and in the Creede district of Colorado are the only important exceptions. A tariff on silver will be a considerable inconvenience to domestic smelters and refineries treating imported base-metal ore or bullion that contains silver. It would mean, if effective, an additional cost of twelve million dollars to domestic consumers. And yet, as indicated, the silver-mining industry proper produces only five or six million dollars' worth of silver annually.

A more serious objection is the doubt as to whether or not the tariff will be effective. Domestic consumption is only two-thirds of total domestic production. Senator Pittman proposes an export association to market the surplus third, pointing to copper as an example of successful operation under the Webb-Pomerene Act, which allows formation of a trust for exporting. He forgets that the situation in copper is somewhat different. No duty is levied on imports of the red metal, and the domestic market is on a par with the world market. Who is to determine what proportion of each silver mine's production is to be sold in the domestic market? The export association? And if it does establish such a ratio, will not that constitute a violation of the Sherman Act? The copper producers simply turn over to the export association a fixed proportion of their production. What they do with the rest is their own business. But in the case of silver, every producer would want to sell as much as possible of his output in the domestic market, if the thirty-cent margin prevailed. Competition for domestic sales would ensue, to say nothing of increased production.

If the ratio to be sold in this country is determined by concerted action, the producers will violate the law; if they do not establish such a ratio, the price will rapidly fall to the world level. And, even if the Department of Justice closes its eyes to a marketing agreement in the domestic market, what is to prevent independent mines from coming into operation and selling their product for slightly less than the established price? Furthermore, how is it possible to control the byproduct output of the copper, lead, and zinc mines? The Pittman amendment appears to *Engineering and Mining Journal* to be a hasty and futile gesture by Western senators to win the favor of their constituents. Mining men who are alive to the realities of the situation will not allow themselves to be hypnotized by such obvious political strategy. Silver needs something more than oratory or an unworkable tariff to be restored to its old price level.

Tin Producers Exhibit More Co-operation With Prices Low

ANNOUNCEMENTS by the Tin Producers' Association indicate that prospects for co-operation in the regulation of production to consuming demand are better now than ever before. Though the Association's membership represents only about one-third of the tin production of the world, outside interests have shown a commendable willingness to restrict production, a spirit strengthened no doubt by present low prices. In fact, those who remain unwilling to agree to any restrictive policy apparently represent only about six per cent of the world production, and are therefore unlikely really to threaten the success of the plan. Producers in the Dutch East Indies and in Bolivia are no longer thorns in the side of the Association.

A production curtailment of about sixteen per cent is reported to have been arranged, but this news has not had much of a strengthening influence on the price of tin, because one may doubt if it will be sufficient to affect the present situation. For instance, the United States uses about 45 per cent of the world's tin, but deliveries in December, January, and February in this important consuming country were only seventy-two per cent of

what they were in the same months a year before. Actual consumption has probably not declined by as much as twenty-eight per cent, as this would indicate, but the reduced rate of production is not likely to balance the decline in consumption. However, the world consumption of tin should improve as time passes; the first quarter of 1930 may well prove to have been the worst, and if the agreed rate of production curtailment persists throughout the year, the statistical position, and the price too, should improve.

Of course, the threat of substitution is always apparent, in this age of rapid commercial development of new materials and of new uses for old ones. The lowly tin can has had a long and honorable career; so far it has successfully resisted almost all competition from glass or other metals. Whether or not it can continue to do so is something to worry about, perhaps, but this has no effect on the present situation. Experiments are being made on transparent acetate containers, but by the time they, or some other substitutes, are accepted by the housekeepers of the world, an ample consuming demand for tin may have been developed in other directions.

Alaska Juneau Enters a New Phase of Its Career

ALTHOUGH virtue, as users of proverbs know, is its own reward, the virtuous find more tangible returns not unwelcome at times. Alaska Juneau has long been known as possibly the most remarkable mine in the world, and the skill with which it has been handled is a feather in the cap of its management. But, although stockholders can point with pride to the achievements of the enterprise, financial returns have not been forthcoming. Situated in a remote part of the world, burdened with relatively high labor costs, handling ore from which the average recovery to date has been about seventy cents per ton, the ability of the company to keep its head above water is in itself a tremendous feat. Within the last two years a turn for the better has been apparent. The grade of ore has improved, and the burden of bonded indebtedness has been almost entirely dissipated. In the annual report, Mr. F. W. Bradley, president of the company, states that within a year and a half the directors hope to be able to distribute the first dividend.

Mining engineers and metallurgists should derive great satisfaction from what promises to be the successful outcome of the Alaska Juneau enterprise after a long and courageous struggle with the complex forces of nature and economics. Since 1910 Mr. Bradley and his engineers have been wrestling with the problem of converting the enormous deposits of low-grade gold ore at Juneau into profits. After building an expensive metallurgical plant in 1915, they found that milling costs were nearly thrice the original estimate of twenty cents per ton and that recovery of gold was barely seventy per cent. Their refusal to admit defeat then was considered by many as foolish. To the layman it might have appeared as an example of stubborn pride. At any rate, experimentation was continued. Important changes were made in the mill in 1919. Costs for 1920 were about forty-five cents per ton. By 1926 they had been reduced to twenty-one cents. Alaska Juneau today handles material that returns, in bulk, about the same gross value per ton as does limestone, crushed to quarter-inch size and delivered to a near-by city. Yet Alaska Juneau is a gold mine, using selective mining and selective milling, requiring a complicate metallurgical process, and distant about eight hundred miles from the market where it purchases most of its supplies and disposes of its product.

Alaska Juneau's first dividend will be a genuine tribute to Mr. Bradley, to his operating staff, to the stockholders who have showed their faith by maintaining an interest in the company, and to the engineering profession as a whole.

Echoes of the Carson Reverberatory Litigation

AMONG the interesting items in the annual report of the American Smelting & Refining Company for 1929 is the statement that the Carson litigation, involving a patent for the side-feeding of reverberatory furnaces, was settled for $1,059,585, all but five thousand dollars of this amount being apportioned to past infringement and charged to the fund for extraordinary obsolescence and contingencies. The report stated that the company discontinued the use of the method several years ago.

Great as this sum is, it is only five per cent of the net income of the A. S. & R. last year, so it will not bear heavily on the stockholders. Nor are the stockholders of other smelting companies involved likely to suffer when they receive their dividend checks. And yet, Mr. Carson and his backers fared well. The total payments for infringement are said to aggregate about fifteen million dollars. Mr. Carson's share is said to be only ten per cent, but even that should not be an unwelcome windfall. Though George C. Carson has been connected with the mining industry most of his life, and has many patents standing in his name, Lady Bountiful, never until recently smiled upon him.

Uniform Engineer-Registration Laws Sought in New Movement

MINING ENGINEERS in general have evinced a pronounced dislike for compulsory registration of engineers since it was first proposed. Some lost their antipathy on finding that the reciprocity feature of state laws made the legislation less onerous than they had anticipated. Many are seemingly as unreconciled as ever.

What cannot be cured must be endured. State registration of engineers has already progressed so far that it appears to be "incurable." Laws in twenty-six states prescribe it, and the chances of their repeal are slim, so forceful does the argument in their support sound to the average lay citizen and legislator. Though the number of states requiring registration is approximately only half the total (a fact without much significance), the

existing situation must be difficult for a consulting engineer who has not yet secured a license in at least one of the states requiring it.

By way of making compulsory registration more endurable, a well-directed effort is under way to insure its uniformity in the future. As an alternative to continuing their opposition to registration, the hitherto unreconciled might adopt constructive tactics and lend the new movement their support.

Engineering and Mining Journal does not advocate registration for mining engineers, but it strongly urges the latter to consider facts, remembering that an ostrich with his head buried in the sand is still visible to his enemies, and to bear in mind that they cannot well divorce their calling from other branches of engineering.

Zinc Sulphate As a Weed Killer

METALLIC SALTS are affording the farmer and others an increasing degree of assistance in their efforts to combat the ravages of insect pests and weeds. This is notably true as regards arsenic, which, in the United States, is employed for such purposes to the extent of about fifty per cent of its total consumption. Calcium arsenate is used against the cotton boll weevil, lead arsenate against fruit-tree pests, and both crude arsenic and sodium arsenate have proved efficient as weed killers. Several other metallic compounds, including paris green—an arsenate of copper—and potassium chlorate, might be cited as available for the destruction of insects and weeds.

Recently, however, the United States Department of Agriculture has developed what to the mining profession might be described briefly as a selective process of weed killing, based on the use of a liquid reagent containing a soluble metallic salt. The method is used in preventing the growth of weeds in seedling beds of evergreen trees. A solution of zinc sulphate applied to the seed bed attacks and poisons the roots of the weeds present as they leave the germinating seeds, but the roots of the sprouting evergreens, being more resistant, are uninjured. Numerous experiments with other chemicals were tried, according to the Department's announcement, but zinc sulphate proved to be the most effective. Various concentrations, other than the preferred one of one and one-eighth ounces of zinc sulphate to one quart of water per four square feet of seed bed, were tried; higher concentrations injured the tree seedlings, and lower ones were not effective against the weeds. The method has the disadvantage of making the soil acid, but subsequent lime-treatment is said to overcome this. Moreover, a compensating advantage accrues from the residual zinc left in the soil. This is particularly true when the seedlings are removed from the bed and the soil is replowed for the raising of peas. The zinc increases the growth of the peas, apparently by stimulating the formation of colonies of nitrogen-fixing bacteria on their roots.

The process may find application to an extent that will affect materially the demand for zinc sulphate. In this particular instance its use effects a twenty-seven per cent economy in the cost of producing two-year-old tree seedlings, besides saving many young trees that would be destroyed or damaged by the former methods of hand weeding. The mining industry contributes the basic metal needed to achieve the result. The process may ultimately be instrumental in assuring to the industry one of its prime requisites—an adequate supply of timber.

"New Process Cuts Radium Cost, Claim"

AT LEAST three Californian newspapers recently lent their columns to a story to the effect that the Mar-John Mines Company was about to perfect a new method for the recovery of radium from rock material obtained from properties near Sheep Ranch, California. In the report by an Associated Press staff writer the impression is created that the supply of the alleged radium rock is limitless, although its character is said to be different from that with which radium is usually associated.

The process is not described in detail, but the president of the company is quoted as stating that by "shocking the constituent elements with their own vibrations" the fractionization of the "ore" is hastened. "The pulverized ore," one learns, "is first put into an acid solution which takes into solution the elements that are soluble in that acid. Then it is shot with the cathode rays and barium added to trap the radium and hold it during the remaining steps of fractionization, in the estimated proportion of 1,000,000 parts of barium to one of radium. Another catalyst is added. Then it is attacked directly with dynamic electricity of a half to three and a half million volts. Sulphuric acid is mixed in, it is filtered, and the residue subjected to intense furnace heat, the final step, except for the checking in the electroscope and on the spectrograph of the drawn-off solution for loss of radioactivity."

Readers of *Engineering and Mining Journal* may draw their own conclusions as to the effect of the introduction of this process on the world radium market. Reports from the Belgian Congo do not indicate any deep concern in the outcome.

Political and Commercial Mineral Policies to Be Studied

AWARD of one of the John Simon Guggenheim Memorial fellowships to Dr. Ernest R. Lilley, associate professor of geology at New York University, was recently announced. Mining engineers and metallurgists might think that an appreciable number of the prizes annually bestowed by the Foundation should go to those electing to study phases of the industry with which the name Guggenheim has been prominently associated. Only one other award of this character has been made within the last four years, however—to Mr. Nelson O. Taylor, in 1929, for an investigation of the chemical factors governing ore deposition from hot aqueous solutions at high pressures. No bias is therefore shown toward the mining industry, the awards being made to the applicants each year

(eighty-five in 1930) who seem most deserving, by virtue of their previous accomplishments and the importance of the subject that it is their purpose to study.

Doctor Lilley is to make a study in Europe "of political and commercial policies regarding the development of mineral resources in the light of the present knowledge of the character and extent of such resources." The subject is well chosen. The policies now pursued abroad and those likely to develop merit careful study. One important factor is that the attitude of the British and some other foreign governments toward the mineral resources within the boundaries of their dominions has changed since pre-War days. The significance and probable future effect of this change should be better understood. The proposal made at times that mineral resources be subject to international control should be analyzed and clarified. If found desirable, the best means of making it effective should be known. Doctor Lilley's study, if perchance it is not to extend so far, will at least be a helpful and indeed an essential preliminary to this end.

In Defense of One Type of Noise

QUIET has its charms, but it can hide nothing. Moreover, an entire absence of noise connotes a respite from physical action, without which no general progress can be made. To crave quiet in relief from distracting surroundings is a normal plea, but to expect any type of advance other than mental to continue without noise is plainly unreasonable.

Noise has its advantages, the greatest of which is that it may hide other and more annoying noises. The idea behind many a noteworthy improvement in ore dressing and metallurgy has been born within close range of the pleasing roar of stamp battery or ball mill. But the industry would have been denied a host of inventions if some efficiency expert had devised a silent mill, and if the nerves of the engineer in charge had been frayed by forcing him to endure a deadly silence, broken at irregular intervals by the raucous screech of a file on the teeth of a handsaw. Similarly, orderly thinking is difficult if not impossible in an office where a not unpleasing blanket of continuous noise has been prevented by the adoption of the silent typewriter, but where the resulting calm is disturbed by loud conversation and machine dictation. Mr. Edison is a good example of the scope for organized thinking and large output if the operation of the mental machine is not interrupted by intermittent noise. He enjoys, so he claims, the benefits of deafness.

A great advance in the study of noise and of its effects on human happiness and achievement will have been made when the fact is more generally realized that one's rest is disturbed not so much by the crowing of the cock as by the nervous tension that develops while one is waiting, expectantly, for the next crow. Better a continuous noise, to which one can easily grow accustomed, with its blessed blanketing effect, than a silence that is interrupted unexpectedly, yet at sufficiently frequent intervals to cause the victim to despair of applying unbroken mental effort to the problem at hand.

Telephone Expansion Programs and Copper Consumption

THE Long Lines Department of American Telephone & Telegraph will spend $106,000,000 in its 1930 construction activities. Plans provide for about three thousand miles of cable, more than one million loading coils, and nearly twenty-eight thousand telephone "repeaters" in connection with new and existing cables. Additional long-distance facilities will result in nearly eight hundred miles of toll cable to be installed by associated companies. Other major projects include the stringing of over one hundred thousand miles of aërial wire and the installation of carrier-current telephone and telegraph systems.

Relief or supplementary cables will constitute an important part of the program. The more important of these will be laid between New York and Chicago, between Pittsburgh and Terre Haute, between New York via Washington to Petersburg, Va., and for about eighty per cent of the distance from Boston to New York.

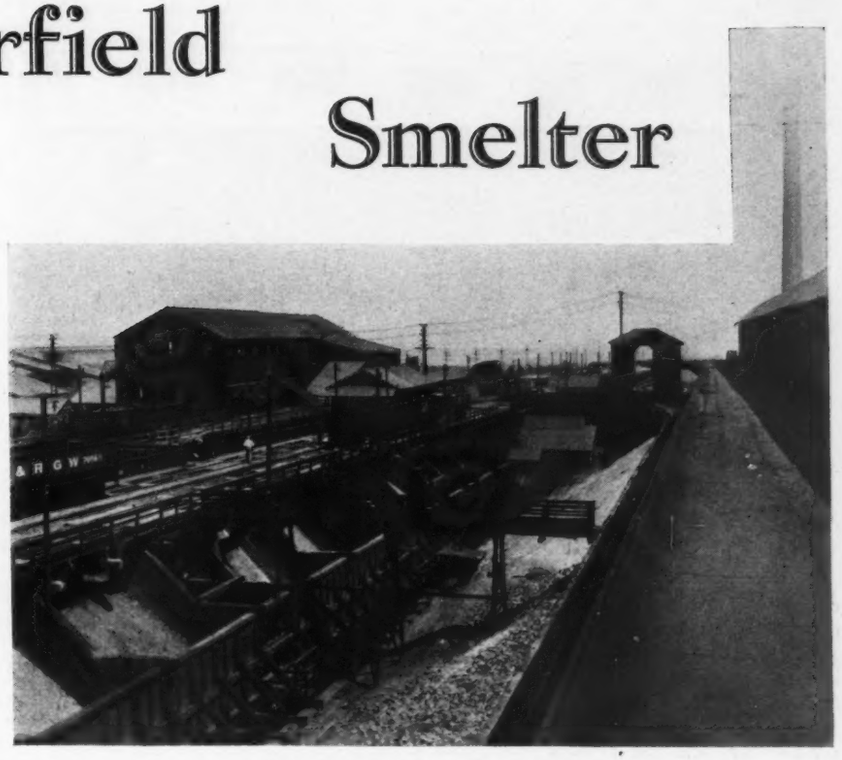
New cables are planned on several additional routes, among them Terre Haute-St. Louis, St. Louis-Kansas City, Milwaukee-Appleton, Wis. Work will be started on a new route between New York and Syracuse, with the construction of new cables from Easton, Pa., via Scranton, to Binghamton, N. Y. New underground conduits are being built from New York to Philadelphia, New York to Reading, Pa., Cleveland to Toledo, and in some other sections where, on account of the rapid growth or other conditions, underground cable is more economical than aërial cable.

The plans for new aërial wire include extensive construction of the Central Transcontinental route from Kansas City to San Francisco and Los Angeles, via Denver and Salt Lake City. About nine hundred miles of additional pole lines will be built in sections between Kansas City, Kan., and Wendover, Utah. Another new pole line will form a direct route between Salt Lake City and San Bernardino, Calif., a distance of nearly six hundred miles. A new pole line, about five hundred miles long, is also being constructed between Albuquerque, N. M., and Kingman, Ariz. This will be the final link in a fourth transcontinental line that will run from Whitewater, Calif., through Kingman, Albuquerque, Trinidad, Colo., and Oklahoma City. It will afford relief to the Southern Transcontinental route, various sections of which are now loaded to capacity. A new open-wire line will be built between Bangor, Me., and the proposed terminal of the transatlantic submarine cable on Cape Breton Island, N. S.

This vast construction program in one industry that absorbs immense amounts of copper is indicative of the fact that saturation is far off, even in the United States, where telephones are more numerous than in any other part of the world. When other countries realize more fully the economy of prompt communication, an impetus will be given to the consumption of copper, which will contribute materially in absorbing the output of all the new copper regions now in process of development. And prompter communication, by telephone, offers but one major opportunity for the increased consumption of nonferrous metals. Transportation of material is rapidly becoming a mechanized operation, even in isolated districts; and the copper industry is likely to continue to supply the most useful metal necessary for the construction of electrical equipment.

The Garfield Smelter

J. B. Huttl



Unloading and ore storage bins

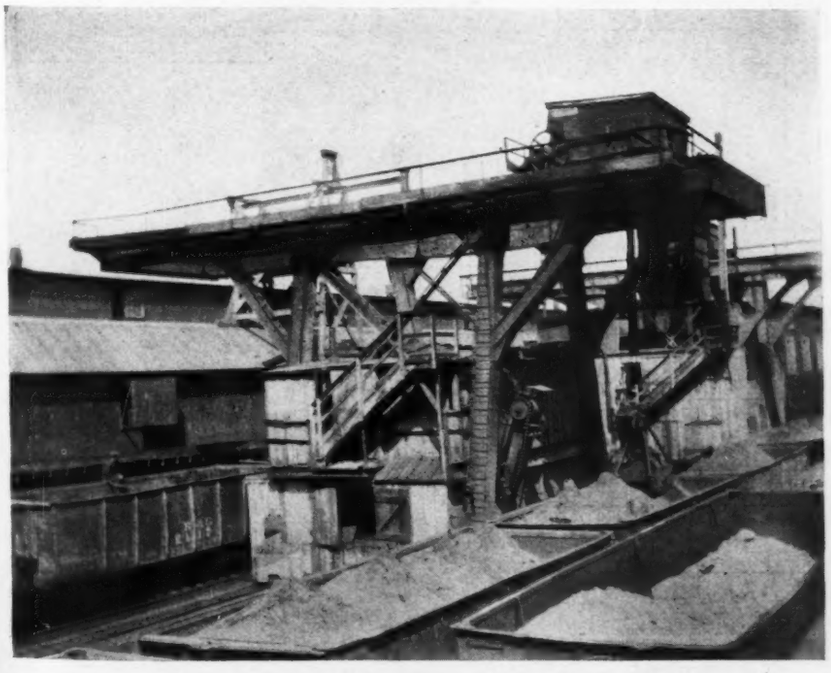
THE Garfield Smelter, an outgrowth of a relatively small copper smelter built in 1906 by the Garfield Smelting Company primarily to treat Utah Copper concentrates and ore, is about 22 miles west of Salt Lake City, Utah, on the shore of Great Salt Lake.

Since the incorporation of Garfield Smelting with the American Smelting & Refining Company, a program of continuous expansion, skillful technical management, untiring efforts with experimental work, and the willingness of executives to scrap equipment costing millions to make room for more efficient machinery, has built up the large and modern metallurgical plant of today, with a smelting capacity of 20,000 tons of copper per month. The Garfield smelter is the largest among four similar plants operated by American Smelting & Refining in the western United States.

Operated as a custom plant, the ore supply is varied. Shipments of crude mine ores, precipitates, dump ores, and tailing from mines in Utah, Colorado, Idaho, California, and Nevada; also of metallurgical products such as lead-plant matte and speiss from the smelting plants, are delivered by three railroad companies—Bingham & Garfield, Denver & Rio Grande Western, and Los Angeles & Salt Lake. The major part of ore supply, however, consists of mill concentrates from the Magna and Arthur mills of the Utah Copper Company.

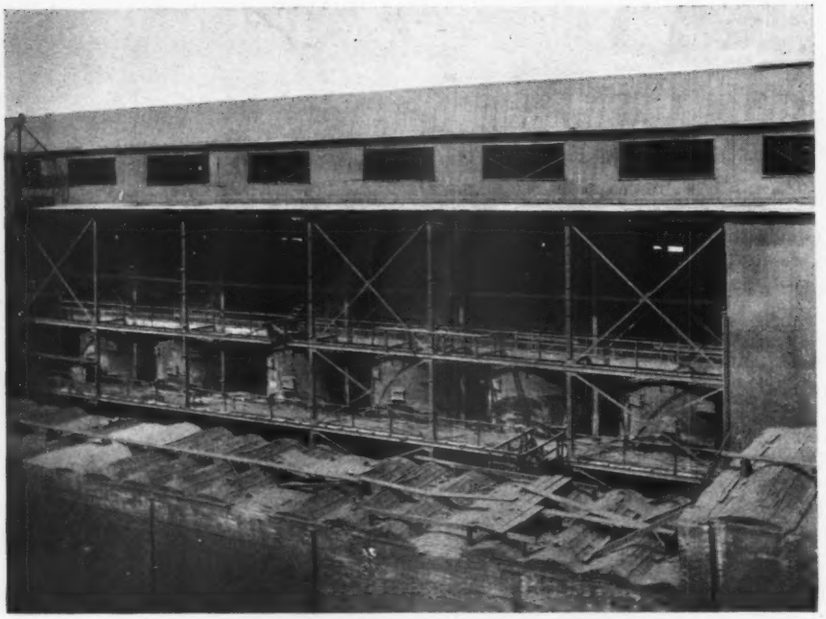
The ores and concentrates are delivered in standard railroad cars to a storage plant of about 54,000 tons' capacity. By an efficient track system these materials are transferred and unloaded over 50-ft. trestles to the storage bins, as indicated in the accompanying flow sheet of the smelter. The bins are wood-frame structures, intimately linked together by a belt-conveyor system. Movable trippers are used for mixing the reverberatory and converter beddings.

For unloading and sampling the Utah Copper concentrates, two electrically operated Martin unloading and sampling machines, developed and built at the Garfield plant, are used. The Martin machine consists of a gantry-type traveling crane, with a built-in structure housing the sampling and conveying machinery; and a clamshell bucket, operated from the crane cab, for unloading the car contents into a hopper on the roof of the building. From the hopper a broad, endless-belt conveyor feeds the concentrate evenly over a revolving drum, the length of which corresponds to the width of the conveyor. Through a slot in the drum a one-tenth sample



Martin concentrate unloading and sampling machine

The first of a series of articles on the American Smelting & Refining Company's enterprises in Utah.



The roaster department

cut is effected. After the sample has dropped through this slot a smaller conveyor operating inside the drum feeds it to a second slotted drum, where the sample is cut one-fifteenth. From this slot the sample is then conveyed to the sample car, and the rejects from both drums fall onto the main conveyor leading to the reverberatory bedding bins. The sample from the Martin machine is taken to the concentrate cutting room, where the individual car samples are combined in predetermined lot combinations. Concentrates other than those from the Utah Copper plants are shoveled to the bedding-bin conveyor, saving every fifteenth shovel as samples, which are then treated in the cutting room, as are the Utah Copper concentrates.

Aside from the two methods described in the foregoing, three other means are employed in the sampling circuit of the smelter: (1) moisture sampling, as soon as a shipment is delivered; (2) standard mill sampling for crude ore and byproducts; and grab sampling for dump ores, tailing, and lime sand.

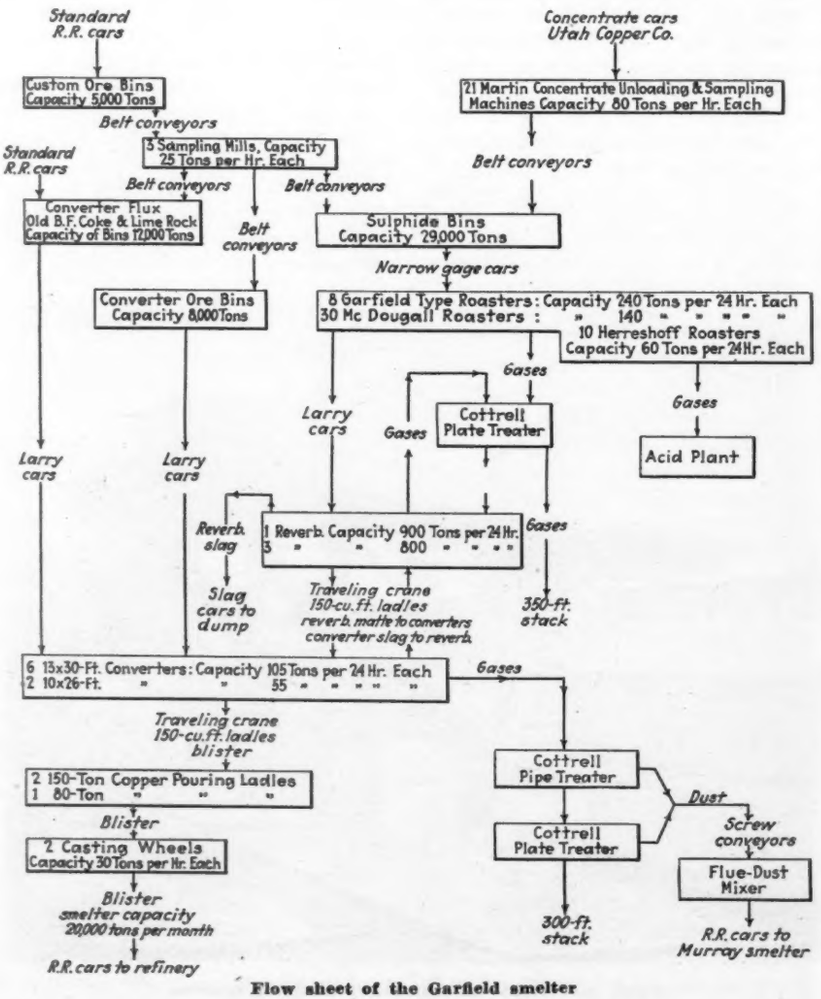
To offer the shipper the quickest service possible, three sample mills are provided to treat custom ore. Each has its individual railroad trestle and bin, but all employ the same system and have similar flow sheets. No. 1 and No. 3 mill serve chiefly to sample and grind crude mine ore. No. 2 is used exclusively for metallurgical byproducts. The customary system of cutting and grinding is used in these mills, the size of the lot to be sampled and of the sample to be sent to the sampling room being determined by the number of cutters used in the mill. Belt conveyors convey the rejects of the three mills to specified bins or to cars. Compressed air connections installed on the sample side of the flow of each mill are employed for cleaning the ore passageways.

All samples taken, including the daily metallurgical samples, are delivered to the bucking room, adjacent to the sample mills, for final preparation for the laboratory. The bucking room building is divided into two sections: On the lower floor, the mill samples are crushed, mixed, and prepared to a workable size. On the upper floor, or bucking room proper, ample drying-plate and oven space is provided for drying purposes. Crushing rolls, coffee-mill grinders, and pulverizers are used to reduce the different classes of material to the required fineness. A noteworthy feature is the efficient ticket system employed in this department, which insures protection to both the shipper and the ore-buying department of the smelter.

Adequate ventilation—large windows and high ceilings—to provide ample air and light, is an important feature of the laboratory. The equipment includes built-in coal-fired furnaces and necessary modern apparatus for fire and wet assaying and general test work.

The Roasting Equipment

The roasting plant consists of 48 roasters, each of 240 tons' capacity per separate steel-frame buildings. Plant No. 1 is equipped with eight 19 ft. 6 in. diameter eight-hearth, Garfield-type roasters, each of 240 tons' capacity per day, and sixteen 18-ft. diameter six-hearth, McDougall-type roasters, each of 140 tons' capacity per day. Fourteen 19 ft. 6 in. diameter six-hearth McDougall roasters, and ten 19 ft. 6 in. six-


Standard R.R. cars
Concentrate cars Utah Copper Co.
Custom Ore Bins Capacity 5,000 Tons
21 Martin Concentrate Unloading & Sampling Machines Capacity 80 Tons per Hr. Each
Belt conveyors
3 Sampling Mills, Capacity 25 Tons per Hr. Each
Standard R.R. cars
Belt conveyors
Belt conveyors
Belt conveyors
Converter Flux Old B.F. Coke & Lime Rock Capacity of Bins 17,000 Tons
Belt conveyors
Sulphide Bins Capacity 29,000 Tons
Narrow gage cars
Converter Ore Bins Capacity 8,000 Tons
8 Garfield Type Roasters: Capacity 240 Tons per 24 Hr. Each
30 Mc Dougall Roasters: " 140 " " " "
10 Herreshoff Roasters Capacity 60 Tons per 24 Hr. Each
Gases
Gases
Larry cars
Gases
Cottrell Plate Treater
Acid Plant
Larry cars
Larry cars
Reverb. slag
1 Reverb. Capacity 900 Tons per 24 Hr.
3 " " 800 " " "
Gases
Slag cars to dump
Traveling crane 150-cu.ft. ladles reverb. matte to converters converter slag to reverb.
350-ft. stack
6 13x30-Ft. Converters: Capacity 105 Tons per 24 Hr. Each
2 10x26-Ft. " " 55 " " " "
Gases
Traveling crane 150-cu.ft. ladles blister
Cottrell Pipe Treater
Dust
2 150-Ton Copper Pouring Ladles
1 80-Ton " "
Blister
Cottrell Plate Treater
Screw conveyors
2 Casting Wheels Capacity 30 Tons per Hr. Each
Flue-Dust Mixer
Blister smelter capacity 20,000 tons per month
300-ft. stack
R.R. cars to Murray smelter
R.R. cars to refinery

Flow sheet of the Garfield smelter

hearth Herreshoff roasters, of which but two are now in operation, each producing 60 tons of calcines per day, compose the equipment of plant No. 2.

The roasters are in two parallel rows and have individual feed hoppers of 20 to 25 tons' capacity each. Automatic apron feeders introduce the charge into the furnace. Oil burners for starting the roasters, and also to increase roasting temperatures when necessary, are provided at the fourth, seventh, and eighth hearths on the Garfield roasters and at the third, fifth, and sixth hearths on the McDougalls. The main shafts and arms are air-cooled by fans supplying air to the bottom of the rotating shaft at a pressure of 3 to 4 oz. Aside from the charge floor, three other floors are provided to make the roasters more accessible to the operators and repair men.

Improvements in selective flotation, with finer grinding, at the Utah Copper Company's mills have resulted in concentrates of higher copper content, with a consequent cutting of tonnage.

The hot calcine, from which a 36 per cent matte is produced in the reverberatory furnaces, is discharged from each roaster into one of two hoppers of 4 tons' capacity each. New square-shaped hoppers, with large discharge doors operated by gear rack and pinion, are replacing the old-type pyramid-shaped ones, in which the calcine often caked, with resultant increased labor costs. The gases of each roaster are discharged through cast-iron goosenecks into a brick flue between the two rows of roasters. This flue, in turn, discharges into the main flue connected to the Cottrell plant.

Bottom-dump cars of 10 tons' capacity, and electric trolley-type locomotives, are used for the transportation of the concentrate and ore over 50-ft. trestles from the sulphide beddings to the charge floor of each roaster building. Dustless, electrically operated larry cars are employed exclusively for conveying directly the hot calcine and collected flue dust from the Cottrell plant to the charge floor of the reverberatory furnaces.

Modern Cottrell plants have replaced the inefficient dust-chamber practice formerly used. All gases from the reverberatory furnaces and roasters, with the exception of those intended for the acid plant, are first treated in a plate-type Cottrell plant adjacent to the roasting department before being discharged through the 350-ft. stack. The Cottrell plate treater consists of six sections, each divided into three treating units, through which a maximum of 750,000 cu.ft. of gas per minute, with a dust content of 13 lb. per 100,000 cu.ft., passes at the rate of 22 ft. per second. Each treating unit, containing from 420 to 440 wires charged with 24,000 volts, is provided with an individual rectifier, thus insuring high operating flexibility. The particles are exposed to the electric charge for about one second, which precipitates the flue dust.

The extracted flue dust is collected in sheet-iron hoppers at the bottom of each treating unit, whence a 12-in. screw conveyor delivers it to the two main bins to be returned to the reverberatory furnaces.

Reverberatory Department

In the reverberatory department one unit, of 900 tons' capacity, measuring 30x140 ft., and three units of 800 tons, 27 ft. 4 in. x 126 ft., are available. The furnaces are of the usual silica-brick construction except for the side walls below the surface level of the molten bath inside, which are of magnesite brick.

All of the furnaces are fired with pulverized coal, 88 per cent —200 mesh, with 2 per cent moisture, which is transferred in revolving-screw conveyors from the storage bins to the burners, and blown into the furnace, using 16-oz. air pressure. From 1 to 1½ per cent oxygen is found in the exit gases. Two 300-hp. Stirling water-tube waste-heat boilers, set in tandem, are provided on each of the three smaller furnaces, and an Erie type boiler is used on the large furnace. A super-heating unit has also been placed in operation recently.

The slag, containing 40 per cent silica, is discharged from the furnace into cast-steel, side-tipping ladle cars and taken to the slag dump by electric locomotive. Four 40-ton traveling cranes and 150-cu.ft. ladles are provided to convey and pour the copper matte from the reverberatory furnaces into the converters.

Experiments are being conducted on a side feeder recently developed at this plant, a description of which I hope to publish later.

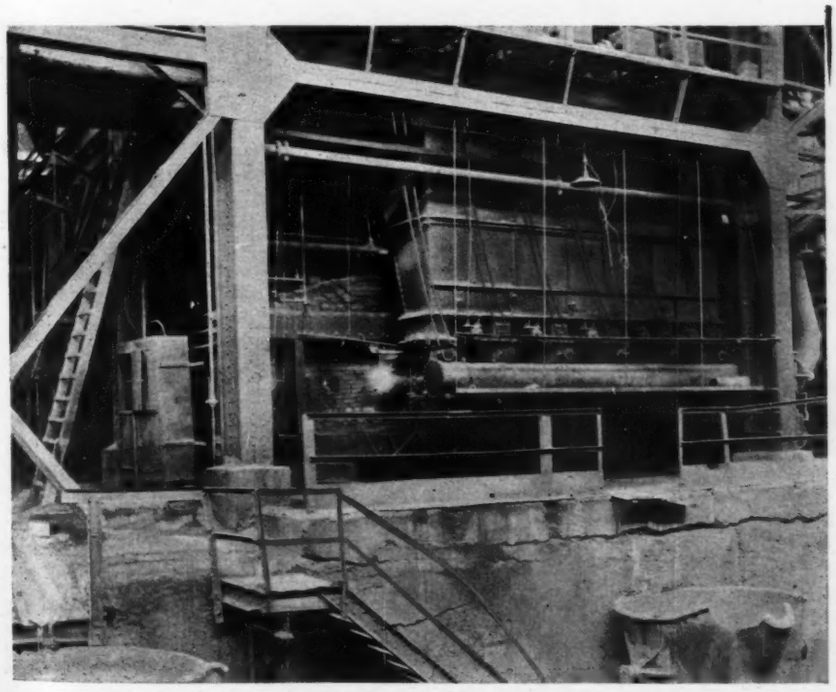
Horizontal Converters Used

The converter equipment consists of six 13x30-ft. and two 10x26-ft. basic-lined converters. Electric larry cars are used to transport the converter ore and flux from the storage bins to the receiving hoppers on the charge floor. Garr guns are employed to blow the flux into the converters. The blast pressure is 14 lb. and the air is delivered through 1¼-in. tuyères.

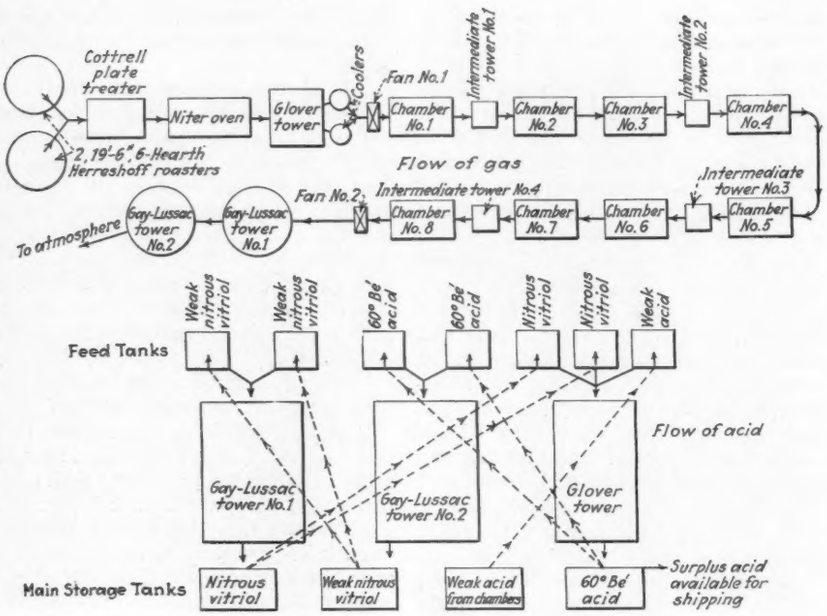
Stationary cast-steel hoods of a new design, equipped with a movable sliding door, operated from an independent guide frame, completely cover the mouth of the converter and convey the escaping gases to the sheet-iron, wedge-shaped flue leading to the Cottrell plant. The converter slag is poured into 150-cu.ft. ladles and thence into the reverberatory furnaces.

The blister copper from the converter is discharged into holding ladles equipped with silica arches and magnesite side walls and bottoms. From these it is poured into the molds of two Walker casting wheels. From the casting floor a steel conveyor elevates and loads the blister cakes into railroad box cars, in which they are shipped to the refinery.

In the western extension of the converter building are six hand-fired and two pulverized-coal-fired boilers of 700 hp. each, and the coal-treating plant. The untreated coal, equal parts of slack and dust coal from the storage bins, passes over a belt conveyor to two rotary coal-fired Ruggles-Coles dryers. A bucket elevator then raises and discharges the dried product into large steel bins. From this point it is evenly fed into the eight available Raymond pulverizing mills. Suction fans deliver the pulverized coal from the mills to the



Firing end of No. 7 reverberatory



Flow sheet of the sulphuric acid plant

storage bins after it has passed through the air separators. From there the coal dust is transported to the reverberatory furnaces as described.

The converter gases are treated in series by two Cottrell plants with a capacity of 300,000 cu.ft. of gas per minute. These gases first enter the pipe and then the plate treater before being discharged through the 300-ft. stack. The former consists of nine units, each containing 160 5-in. pipes, with their respective electric elements, and an individual rectifier. The plate treaters are in seven sections, divided into five treating units each, which have the same arrangement as the roaster plate treater. Contained particles are exposed to the electric charge of 20,000 volts, 0.8 seconds in the pipe and 0.9 seconds in the plate treater.

Another important and interesting item in the flow sheet of the Garfield smelter is the sulphuric acid plant—a large brick building, situated but a few yards west of roasting plant No. 2 and operated under joint agreement with Utah Copper.

The necessary gases are obtained from two of four available 19 ft. 6 in. diameter six-hearth Herreshoff roasters, treating a pyrite ore averaging 38 to 40 per cent sulphur. A small Cottrell plate treater is provided to treat the roaster gases before they enter the cast-iron niter oven. The gases, before being discharged into the atmosphere, pass through and are treated in the following apparatus: A cast-iron niter oven for generation of the niter oxide gases and conversion of sulphur dioxide into sulphur trioxide; a 16x16x42-ft. Glover tower, with two coolers, serving as a concentrating and denitrating tower for weak acid from the lead chambers and of nitrous vitriol from Gay-Lussac towers, respectively; a chamber system, consisting of two 32 ft. 5 in. x 37 ft. 5 in. x 54 ft., two 32 ft. 5 in. x 37 ft. 5 in. x 67 ft., two 32 ft. 5 in. x 37 ft. 5 in. x 83 ft., two 32 ft. 5 in. x 37 ft. 5 in. x 93 ft. lead chambers, and four intermediate towers 8x16x37 ft., where, by conversion of sulphur dioxide into trioxide and the adding of water, sulphuric acid is produced; and two Gay-Lussac towers, 20 ft. in diameter and 46 ft. high. The flow of the gases is regulated by two large lead fans, of which No. 1 is situated between the Glover tower and chambers, and No. 2 between the chambers and the Gay-Lussac tower No. 1.

In a continuous cycle of the process 60-deg. Bé. acid from the Glover tower, weak acid from the lead chambers, weak nitrous vitriol from Gay-Lussac tower No. 2, and nitrous vitriol from tower No. 1 are collected in separate main storage tanks and pumped back to the seven corresponding tanks above the aforementioned apparatus and shown in the flow sheet. The surplus of the 60-deg. Bé. main acid tank is the product available for shipment.

With a second unit, consisting of one Glover tower, two lead chambers, four intermediate towers, two lead fans, and two Gay-Lussac towers, about 150 tons of 60 deg. acid are produced per day.

In connection with the units mentioned in the foregoing, a concentrating plant of the cascade system is maintained to produce 93 per cent sulphuric acid. The plant is divided into four individual coke-fired units employing a total of 38 high-silicon iron evaporating pans with a capacity of 50 tons of high-grade sulphuric acid per day.

The power house for generating power and air for the various smelter operations contains:

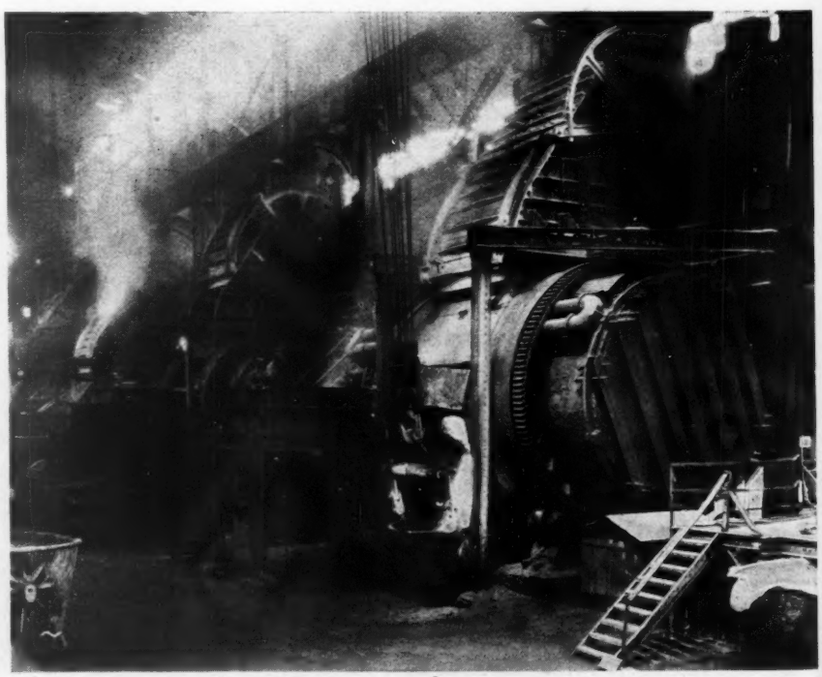
For supplying converter air at 14-lb. pressure:

One Nordberg, horizontal, cross-compound, duplex, steam, blowing engine. Normal capacity 30,000 cu.ft. per minute.

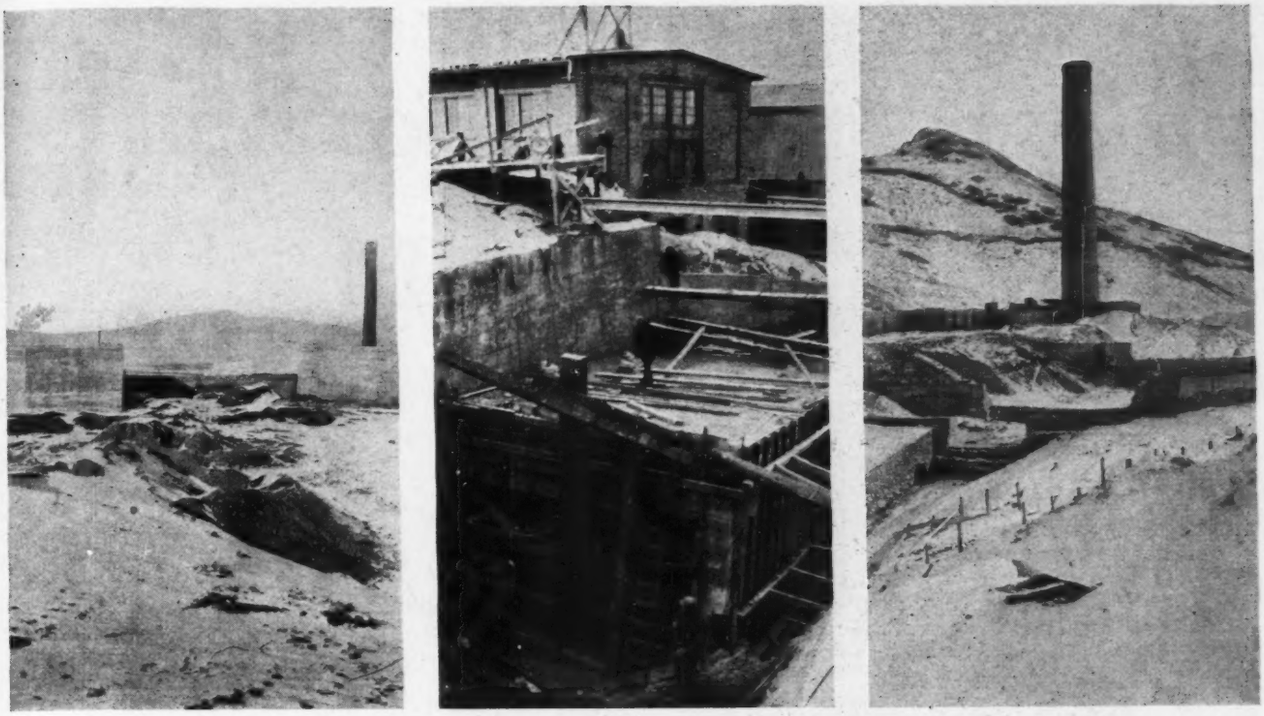
One Allis-Chalmers, horizontal, cross-compound, duplex, steam, blowing engine. Normal capacity 30,000 cu.ft. per minute.

One Ingersoll-Rand turbo blower, 30,000 cu.ft. capacity per minute.

Three Nordberg horizontal cross-compound, duplex, steam, blowing engines, with a normal capacity 18,000 cu.ft. per minute.



In the converter building



The main concrete dam of the flood control system is shown at the left; in the center is a view of the 1,400-ft. reinforced submerged drain tunnel; and on the right are shown some of the concrete dams and spillways

For supplying air at 16-oz. pressure to burners on the reverberatory furnaces:

Two Connersville blowers of 30,000 cu.ft. capacity per minute, directly connected to Allis-Chalmers, horizontal, tandem, steam engines.

Power generating units:

One 1,500-kw., a.c. Westinghouse turbine.
One 1,000-kw., a.c. Westinghouse turbine.
One 1,500-kw., d.c. Westinghouse turbine.
One 1,000-kw., d.c. Westinghouse turbine.
One 750-kw., a.c.-d.c. Ridgway Dynamo & Engineering Company motor-generator set.
Two 600-kw., d.c. Nordberg, horizontal, compound steam engines.
One 250-kw., d.c. Allis-Chalmers horizontal, compound steam engine.

Condensers, compressors, pumps, and other auxiliary equipment:

Ten condensers, with the necessary auxiliary machinery.
Four steam-driven boiler feed pumps.
One electric-driven boiler feed pump.
Two steam-driven hydraulic pumps.
Three steam-driven fire pumps.
Two Webster feed-water metering heaters.
One Class OCR-3 Ingersoll-Rand steam-driven air compressor.
One Chicago Pneumatic steam-driven air compressor.
One Geo. J. Leyner Engineering Works steam-driven air compressor.
One switchboard for alternating current.
One switchboard for direct current.
One electrically driven 20-ton traveling crane.

Steam from the boiler plant is delivered at 150 lb. pressure. In the power house is an electrically operated fire-recording system, of ingenious design and construction, which automatically shows the exact location of a fire.

Water for plant operations, obtained from what are known as the Mill and Factory creeks about seven miles west of Garfield, is conveyed by gravity in a wood-stave pipe to a storage pond at the smelter. From this point Allis-Chalmers centrifugal pumps distribute it. In the event of breakage of the main supply pipe, water can be obtained at short notice from an emergency storage tank of 1,000,000-gal. capacity.

Spray-nozzle cooling ponds and fuel-oil storage tanks, with their respective pumping equipment, are adjacent to the converter building.

The mechanical and electrical departments of the Garfield smelter are on the order of large manufacturing plants, consisting of a large foundry; machine, electrical, boiler, blacksmith, pipe, carpenter and pattern-maker shops; and a tool room. Every department is well equipped with modern machinery and tools, and electrically driven traveling cranes facilitate the handling of materials. All shops are accessible by standard-gage tracks. Apart from the general repair and construction work, the Garfield shops also execute orders for all plants which the company operates in the western United States, Mexico, and Peru. To illustrate the production capacity of these departments, the foundry alone in 1929 produced 27,363 gray-iron castings weighing 1,558,954 lb., and 3,297 brass castings of a total weight of 30,421 lb.

Steam and electric locomotives, steam-driven cranes, power shovels, and Fordson tractors have cut the transportation and labor costs to a minimum.

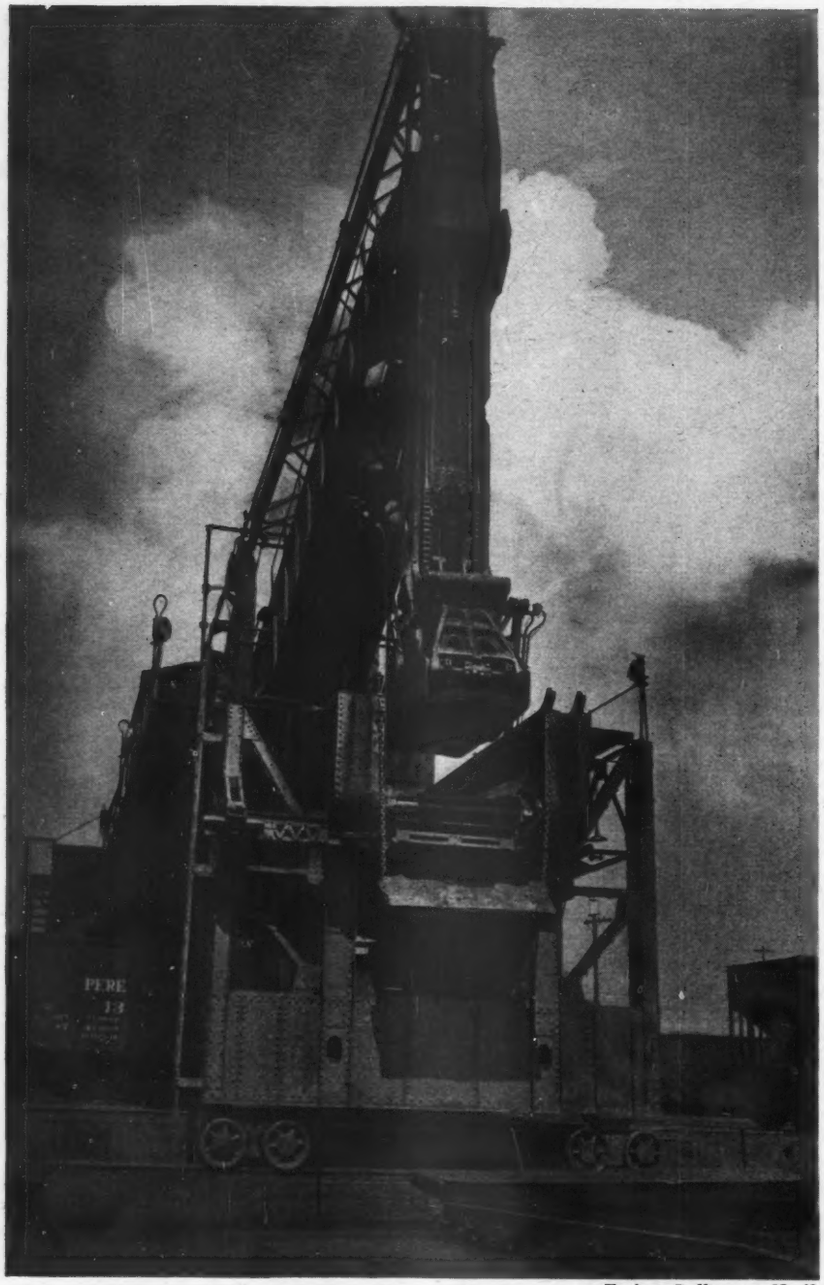
Adequate protection from flood hazards, caused by heavy rainfalls in the adjacent valleys, will be afforded by the flood-control system now under construction—a series of dams and spillways and a submerged reinforced-concrete tunnel the cross-section of which is 295 sq.ft., by 1,400 ft. in length.

Great interest is taken in welfare and safety work by the American Smelting & Refining Company. In addition to the "Safety-First" department, a well equipped hospital is maintained.

Attractive brick bungalows and excellent school facilities are provided at the model town of Garfield, about 1½ miles east of the smelter; suitable quarters have been built for the foreign labor element, with an individual school.

In the smelter grounds are the attractive homes of the various smelter officials; also a clubhouse, with library, recreation hall, dining room, billiard room, and living quarters for the unmarried men.

My thanks are due to W. J. O'Connor, general manager of the Utah Department of the American Smelting & Refining Company, for his co-operation in furnishing information included in the foregoing account; also to R. A. Wagstaff, assistant general superintendent, and to the respective department superintendents of the Garfield smelter, for their co-operation and assistance.



Ewing Galloway, N. Y.

From Ship To Car In 7-Ton Bites

IRON ORE in the Lake Superior region is transferred from steamer to car in a Gargantuan manner by an electrically operated grab. Courtesy *Electrical World.*

The Problem of Essential Minerals—II

A. H. Hubbell
Associate Editor

OF the three other historic "war minerals" — chromite, potash, and pyrites[5]—the first two are conspicuous at the moment, although not now produced in the United States to more than a negligible extent. Chromite is in the limelight because of the present great popularity of chromium and its compounds, and potash because of recent discoveries in New Mexico and Texas. Each was deemed to be essential to the conduct of the war. The essentiality of potash for agricultural and explosive purposes is beyond all doubt. That of chromite is not quite so evident on the surface. But the official view in Washington is that chromium and its compounds have lost none of their war-essential character. This view may be summarized as follows:

Chromium probably follows close after manganese in its importance as a strategic metal. Its principal uses are: (1) for making alloy steel; (2) as furnace lining; (3) in the dyeing industry, and as a pigment; (4) in tanning; (5) in chromium plating. Of these the first is the most important. In specific cases investigated it appears possible to substitute other alloy steels for chrome steel, should the latter not be obtainable, although such substitution sometimes involves sacrifice of characteristics of sufficient importance to make it undesirable. Such substitution within reasonable limits can safely be effected by the interchangeable use of not only chromium and molybdenum but also nickel. This substitution can probably be made only within limits, however. In other words, although it may be possible to get equally satisfactory physical characteristics by the use of other alloying elements or combinations of them, there may be some characteristics peculiarly inherent in chromium and not possessed by the other elements which would make substitution impossible or at least impracticable. Furthermore, chromium will continue to increase in importance, not only from a military point of view but particularly from an industrial one. In general, military preparedness can be considered much more firmly established when it rests on a sound industrial basis than when it contemplates a radical change to meet newly developed conditions caused by an emergency. Therefore, two particular reasons emphasizing the importance of a future chromite supply are apparent: First, because of the well-defined trend of requirements for industrial purposes; and, second, because of the need of it in an emergency as directly connected with its industrial use.

THESE points are most convincing. Furthermore, as to the possibility of substitution, it may be said that such changes, even when dictated by necessity, are often not readily effected. Prolonged use of a certain raw material becomes entwined with customs not easily altered, and those employing it develop special skill which they lack with other raw materials, and on these practical considerations it may be termed essential as much as on the technical grounds that it possesses characteristics that cannot be duplicated.

The contention may be made, however, that the same argument as that advanced can be made for the essentiality of many other raw materials on which industry has come to depend because trade practices have grown up around them. "All metals are essential," recently exclaimed the official of a certain company manufacturing ferro-alloys, when asked his opinion on the subject. One would have to do considerable thinking, indeed, to call to mind a single metal, widely used by industry in the past, which has fallen into disuse. Application of a metal may change as price differences cause substitutes to displace it here and there, but rarely does one ever fall into complete disuse. Nevertheless, it should be borne in mind that, although many raw materials are indeed essential in the conduct of a war, and although the argument made to establish the essentiality of chromite can be applied to them with varying force, only ten of all the minerals required by the United States in the war with Germany are today found deficient in domestic supply. In addition to those already mentioned, there are nickel, antimony, tin, mica, platinum, tungsten, vanadium, and graphite. These will be considered subsequently.

Chromite appears, then, to be justly regarded as a war-essential mineral. The question therefore presents itself, how may a supply of it be assured to the country in case of war? Can it be obtained at home? Investigation returns the following answer: A domestic chromite mining industry is practically non-existent (368 tons was mined and 660 shipped in 1928), this having been the case ever since the war-built industry foundered in a chrome-flooded[6] market shortly before the Armistice. Subsequent efforts to secure a protective tariff failed, the Fordney-McCumber Act of 1922 leaving the mineral on the free list.

SOME, however, not to be discouraged, are again turning a speculative eye to domestic chromite. Since 1922, consumption of the mineral (almost all of it being imported) has been increasing rapidly. World production, which in 1924 reached the then unusually large figure of 240,000 tons, was 449,000 tons in 1928. In the latter year imports into the United States were 216,592 tons, this figure being dwarfed, however, by the 317,630 tons brought in in 1929. Prediction as to the future is difficult. Present indications betoken possibly some immediate recession in consumption, to be followed ultimately by an acceleration in its rate.

Chromium's commercial possibilities, which indirectly have a bearing on its essentiality in war, lie in its great hardness, its high luster, and its resistance

[5]The first installment appeared in the March 24 issue. Brief reference was made to manganese. The case of chromite is here discussed. Pyrites is no longer considered an essential.

[6]Flooded by reason of importation of chromite as ballast at a time when imports were supposedly restricted to release ships for moving troops and war supplies.

to atmospheric corrosion. Further, chromite refractories are being increasingly substituted[7] for those of magnesite, because of a favorable price differential. Chromium reagents are apparently increasing in favor in the tanning industry.

To determine whether or not the development during peace of a domestic chromite industry would be desirable or advisable for its possible peace-time advantages is not my purpose. But, inasmuch as such development would also solve the problem of insuring a supply of chromite in an emergency that would curtail imports, this article may properly inquire under what conditions it could be effected. Obviously, as is apparent to those familiar with the history of the war-time industry, a tariff would be needed.

The war showed that small low-grade deposits of chromite are widespread in the United States.[8] When conditions permitted, these deposits were actively exploited. In general the ore required beneficiation. Finally such a production was reached that in 1918 about two-thirds of the domestic requirement could have been met by domestic and Canadian ore, and half the remainder by ore imported from Cuba, Guatemala, and Brazil. The price in June, 1918, reached a peak of $72 per ton for 48 per cent ore. Only under such exceptional conditions as existed during the war will a large domestic chromite mining industry be possible[9]—that is, without protection.

AS PREVIOUSLY stated, if a plea is to be made for tariff protection for a given mineral raw material to stimulate its development as a measure of preparedness, it is proper to inquire, first, as to the essentiality of the mineral, and, second, as to the size of the domestic resource to be protected, it appearing useless to protect a small, easily exhaustible resource. Inasmuch as chromite appears to be justly regarded as essential, it remains now to direct attention to the size of the domestic reserve of chromite in its relationship to probable demand.

In 1923, the chrome subcommittee of the committee on foreign and domestic mining policy of the Mining and Metallurgical Society of America reported the total reserve of chromite in the United States as 1,208,000 tons, of which 1,084,000 tons was "difficultly accessible," being more than 20 miles from railroad shipping point. Of the total, 276,000 tons was reported as being over 40 per cent Cr_2O_3, and the balance, 932,000 tons, between 30 and 40 per cent. Commenting on these figures in its issue of Dec. 22, 1923, *Engineering and Mining Journal* said editorially, "They are the best figures obtainable and therefore the figures to which we must tie."

During the war, according to the same report, the chief sources of domestic chromite were California and Oregon, a negligible quantity also coming from Montana, Wyoming, and the Appalachian region. During the last years of the war, important deposits were discovered and partly developed in Alaska and Montana, those in Montana being said to be not only lower in grade than most of those on the Pacific Coast, but also not capable of being raised to high grade because of low chromic oxide content.

THE report, summing up, said that the United States had apparently about twelve years' normal supply and that very likely these reserves would in time be materially increased. Twelve years was arrived at on the basis of the prospective annual consumption at the time the report was written (1923). Actualities have outrun expectations, inasmuch as in 1928, just five years later, the United States imported 216,592 long tons, and in 1929, 317,630 long tons, and the present popularity of chromium and its products would indicate a continuance of importation at an accelerating rate.

Probably the actual reserve is larger than is indicated by the tonnage figures given. The latter are undoubtedly conservative. Moreover, the deposits thus far discovered are the ones most easily found; that is to say, they are not the result of intensive prospecting. Such intensive study of chromite areas would probably result in new additions being made to the reserve, as has happened in the case of manganese. But it should be borne in mind that, in practice, development has shown few individual chromite deposits to be extensive. Those of primary character (excluding residual and alluvial deposits), according to E. F. Burchard, have been found to be so variable in size and shape that it is very doubtful whether they may be expected to extend to as great depths as it would be practicable to mine the ore, although according to the magmatic mode of origin generally ascribed to them, they might be expected to persist in depth. Of the Montana deposits, Lewis A. Smith ("Mineral Resources," 1928, p. 70) has recently said: "The extensive chromiferous serpentine area in Stillwater and Sweet Grass counties, Montana, has only been prospected on the east and west ends, where promising deposits have been shown . . . Further prospective work may disclose new and valuable deposits."

Despite the probabilities mentioned in the preceding paragraph, however, domestic consumption of chromite appears to be increasing much too rapidly to warrant the assumption that the domestic reserve would last long enough, if worked, to justify a plea for a protective tariff. More work must be done before a definite conclusion can be reached that the reserve is or is not ample enough to supply domestic needs for more than a very limited period. Judgment as to the advisability of attempting to stimulate its development with a tariff as a measure of war preparedness must therefore be suspended until more facts are available. Should the reserve be demonstrated to be large in proportion to prospective demand, however, development under protection would appear to be amply justified.

The strategic importance of chromite is such that the government would seemingly be justified in undertaking a geophysical survey of the known chromite areas, such work to be supplemented by test-drilling wherever favorable indications might be obtained. To those who argue that the government already knows it has sufficient chromite for an emergency reserve, if only it be left untouched, one may reply that too much cannot be known regarding the country's resources of the war-essential minerals mentioned.

IN CLOSING, it may be pointed out that, even without a tariff, domestic chromite may find a limited market for refractory purposes where its composition and distance from consuming points permit. This channel of consumption, however, cannot be expected to afford an outlet for any large amount.

To be concluded

[7] Lewis A. Smith, "Mineral Resources," 1928.

[8] Edward Sampson: *E. & M. J.*, Feb. 24, 1923, pp. 356-8.

[9] Same as preceding.

The Anyox Concentrator of the Granby Company

W. B. Maxwell

Mill Superintendent

FOR YEARS, the ores treated at Anyox, B. C., by the Granby Consolidated Mining, Smelting & Power Company, Ltd., were smelted directly in blast furnaces, semi-pyritically; but, more recently, thought had to be given to the possibility of flotation concentration of the more refractory ores, and those of a lower sulphide content, adjacent to the deposits theretofore worked. First, a small pilot mill and test plant were erected, followed, in 1923, by the first 1,000-ton unit of the present 4,800-ton plant. This first unit was put in operation March 17, 1924. The article presented herewith will discuss the equipment and operation of the completed plant.

A large proportion of the Hidden Creek ore was not suitable for semi-pyritic smelting, but it could be concentrated, and as the milling became more efficient and economical, the direct-smelting operations were decreased and milling operations increased. At present, only one blast furnace is operating, treating 400 tons a day of new ore, and the concentrate, after sintering, from the 4,800-ton a day milling operation. Though only one furnace is in operation, the rest of the smelter is up to capacity, and about the same amount of blister copper is produced now as before the concentrator was built.

The milling ores are received from the Hidden Creek and Bonanza mines. A large percentage is mined by the glory-hole method. The climate is severe, with particularly long periods of rain, which makes the heavy iron sulphide wet and sticky. Oxidation, with resultant soluble salts, has some detrimental effect on flotation. The copper occurs as chalcopyrite intimately associated with pyrite and pyrrhotite in a silicified greenstone gangue, and carries small amounts of gold and silver.

Granby's concentrator is about one mile from the Hidden Creek mine, where the primary crushing plant is situated. The ore is hauled out on the 385-ft. level and dumped into bins, where mill and smelter ore are segregated. Mill ore is crushed in a 30x42-in. Blake, and the 9-in. product goes into large underground pockets beneath the crushers. These pockets lead down to the 150 level, from which the ore is loaded into 25-ton cars and hauled to the mill by 42-ton electric locomotives.

The Bonanza mine is situated about two miles from the mill. There, also, is a crushing plant, where the ore is broken to about 8 in. and delivered by aerial tram to a bin near the scale house, and then hauled to the mill bin by railroad trams, with intermediate weighing on railroad scales.

Secondary crushing and coarse grinding are carried on in a building adjacent to the main mill building. When the tonnage rate of the mill was increased from 1,000 to 4,800 tons per day, the coarse-ore bin, which had a capacity of 2,000 tons, was not enlarged. The only addition to the building was space for two 10-in. finishing crushers and two conveyors to bring the crusher product back to the screen tower. All other installations necessary for the increased tonnage rate were fitted into the original building.

Fig. 1 makes clear the flow sheet followed. The main object of the grizzlies is to take out some of the wet fines, which cause trouble in the crushers. The product from the 10-in. gyratories is about 5 per cent + 2 in. One of these 10-in. crushers is a standby, used in event of repairs to the other or when necessary if the ore is especially wet and sticky. Further reduction of this crushed product is effected by rolls in closed circuit with screens as shown. The 72-in. rolls run at 74 r.p.m. and the 54-in. at 108. All rolls are belt-driven from countershafts, through reduction sets from motors. The 72-in. rolls are equipped with a 250-hp. motor and the 54-in. rolls each require 200 hp.

Forged chrome-steel shells are used on all rolls, these being 9 in. thick on the 72-in. rolls and 5 in. thick on the 54-in. The final thickness is about ¾ in., and special effort is made to keep the feed and rolls adjusted so that no corrugations develop. Both the large and small roll shells last approximately 80 days, giving an average consumption of roll steel of about 0.11 lb. per ton of ore. The rolls and 10-in. crushers are served

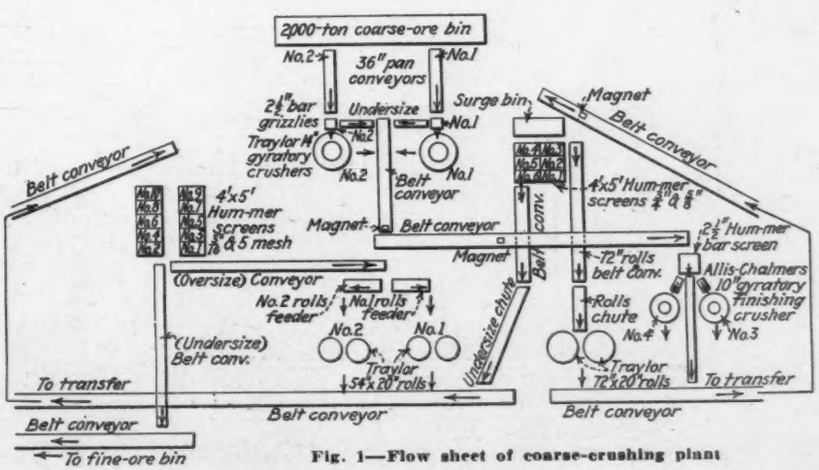
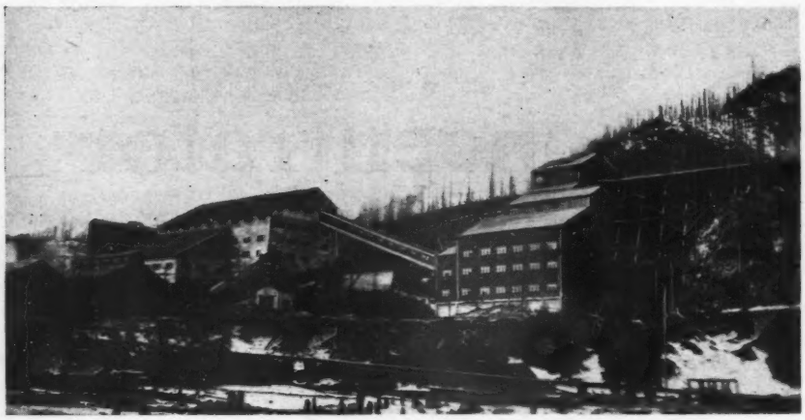


Fig. 1—Flow sheet of coarse-crushing plant



The Anyox concentrator

by a 25-ton crane. All conveyors in the plant are equipped with roller-bearing idlers and driven by roller chains through reduction sets from the motors. The product of this section of the plant is the feed for the fine-grinding section and is conveyed to a 2,000-ton catenary bin. It is about 2 per cent +6 mesh and contains about 3 per cent moisture.

Fine Grinding in Ball and Rod Mills

The fine-grinding equipment (see Fig. 2) is divided into three sections, each of the first two consisting of one single-pass primary 6x12-ft. Cole-Bergman rod mill and two secondary 6x12-ft. Cole-Bergman rod mills converted into ball mills. These two mills are each in closed circuit with 12x20-ft. Dorr classifiers. The remaining section consists of three Cole-Bergman 6x12-ft. rod mills, one open-circuit primary grinding mill, and two secondary mills in closed circuit with 12x20-ft. classifiers. The rod mills require 112 hp. to drive them, at 16.2 r.p.m., and the ball mills 200 hp., at 24 r.p.m. All mills are driven by helical gears and pinions through reduction sets from the motors.

Discharge of the mills is about 75 per cent solids. The primary mill discharge is sent back to the secondary mill classifiers by 6-in. Wilfley pumps. This classifier sand is the feed to the secondary mills, and contains about 80 per cent sulphides. Classifier overflow is about 65 per cent — 200 mesh, at a density of 32 per cent solids content.

For grinding, 2½-in. forged steel balls or 3-in. by 12-ft. low-carbon rods are used. The liners are of manganese steel. Average steel consumption for grinding media is 1.54 lb. per ton, but no data on liner consumption are available. Until recently, white-iron liners cast locally in the company foundry were used.

All mills are served by a rebuilt Niles 40-ton two-carriage crane, which really lifts and carries loads of 65 tons. A spare mill, ready to be installed, is kept in the repair bay, from which it is transferred by crane, thus saving considerable time. The end is taken off the mill to be repaired, after which the mill is lifted with the crane and the balls are emptied into two 15-ton containers. This ball charge is then put into the spare mill (which is now ready to run) by placing a spout in the discharge end of the mill and pouring the balls from the containers (which are held by the crane) into the mill while it is running.

Flotation

The first 1,000-ton unit of the flotation section was equipped with cells of the pneumatic grid type. These were very unsatisfactory on this heavy sulphide ore. After some experimenting with other pneumatic cells those in charge decided to install Minerals Separation Sub-aëration flotation equipment, of which the section at present is equipped with four 24-in. 14-cell, one 24-in. 12-cell, and five 24-in. 10-cell ma-

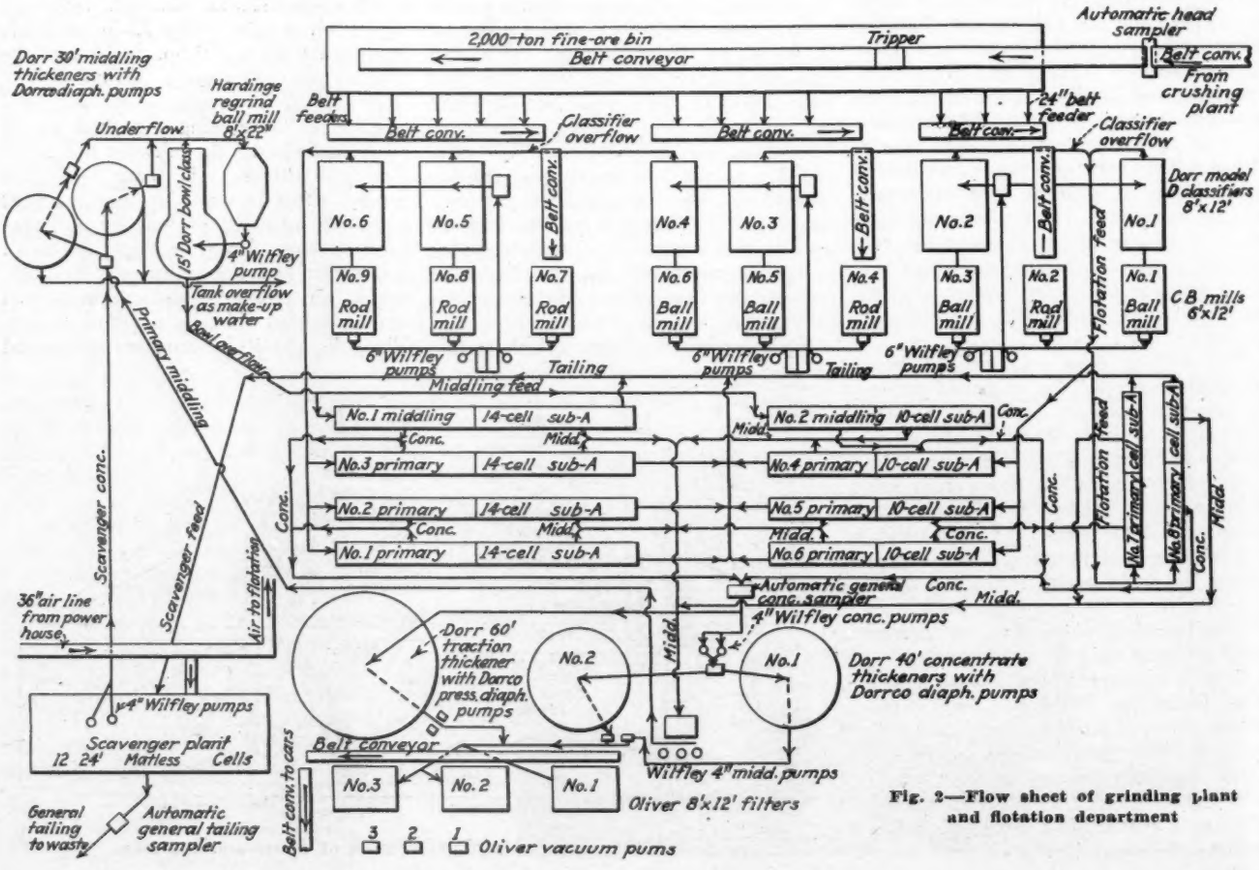


Fig. 2—Flow sheet of grinding plant and flotation department

General Tailing

Per Cent Cu	Per Cent Fe	Per Cent S	Per Cent "Insol."
0.0960	24.1	17.9	49.3

Mesh	Per Cent Weight	Cumulative Per Cent Weight	Per Cent Cu	Per Cent Weight Cu	Cumulative Per Cent Weight Cu
+48	3.85	3.85	0.19	6.79	6.79
65	6.48	10.33	0.23	13.84	20.63
100	10.13	20.46	0.19	17.87	38.50
150	10.60	31.06	0.13	12.81	51.31
200	9.64	40.70	0.09	8.44	59.75
325	26.03	66.73	0.06	15.65	75.40
—325	33.27	.....	0.08	24.60	.....

Typical Screen Analysis and Assays

Mesh	Per Cent Weight	Cumulative Per Cent Weight	Per Cent Cu	Per Cent Weight Cu	Cumulative Per Cent Weight Cu
+6	2.39	2.39	0.83	1.75	1.75
8	8.96	11.35	0.84	6.59	8.34
10	14.54	25.89	0.91	11.57	19.91
14	8.61	34.50	0.96	7.24	27.15
28	15.96	50.46	0.99	13.83	40.98
35	6.71	57.17	1.10	6.46	47.44
48	5.15	62.32	1.13	5.09	52.53
65	4.70	67.02	1.16	4.76	57.29
100	4.75	71.77	1.31	5.44	62.73
150	4.02	75.79	1.42	5.00	67.73
200	3.13	78.92	1.48	4.06	71.79
325	7.54	86.46	1.53	10.07	81.86
—325	13.54	.....	1.53	18.14	.....

General Concentrate

Per Cent Cu	Per Cent Fe	Per Cent S	Per Cent "Insol."
16.40	35.2	34.0	9.5

Mesh	Per Cent Weight	Cumulative Per Cent Weight	Per cent Cu	Per Cent Weight Cu	Cumulative Per Cent Weight Cu
+100	0.78	0.78	21.4	1.04	1.04
150	2.65	3.43	25.7	4.15	5.19
200	4.47	7.90	25.1	6.92	12.11
325	28.51	36.41	18.7	32.64	44.75
—325	63.59	.....	14.2	55.25	.....

General Mill Data

Dry tons milled per day	4,800
Mill feed, per cent copper	1.20
Mill concentrate, per cent copper	16.0
Mill tailing, per cent copper	0.11
Ratio of concentration	14.87 to 1
Per cent recovery copper	91.63
Per cent iron rejection	91.00
Reagents, pounds per ton:	
Hydrated lime	2.26
Cyanide	0.021
Collector oil	0.17
Xanthate	0.06
Pine oil	0.06
Power consumption per ton of ore (including primary crushing at the mine), kw.-hr.	16
Tons per man-shift (includes besides all operating and general mill repairs, the making of wearing parts in departments outside concentrators)	47.5

Typical Screen Analyses and Assays

Mill Feed

Per Cent Cu	Per Cent Fe	Per Cent S	Per Cent "Insol."	Per Cent Moisture
1.16	22.0	16.2	47.8	3.13

chines. Three of the 14-cell machines and five of the 10-cell machines are called primary flotation machines and treat the classifier overflow, which has been diluted to 25 per cent solids. From the first half of these machines a finished concentrate that will assay about 20 per cent copper is taken off, and from the remainder of the machines a low-grade attached copper-iron sulphide middling is floated and sent to the regrind plant. After dewatering in Dorr thickeners and regrinding to 96 per cent —200 mesh in an 8-ft. by 22-in. Hardinge ball mill in closed circuit with a 15-ft. Dorr bowl classifier, it is refloated in one 14-cell and one 12-cell machine. A finished concentrate is taken off these two machines and the tailing, plus the primary cell tailing, with the usual plant spills that go into the tailing launders, are treated further in a scavenging plant. This scavenging plant consists of twelve 24x4-ft. locally designed matless air cells, supplied with air from a 400-cu.ft. per revolution Connersville blower at a 30-oz. pressure. Concentrate from these cells is pumped back to the middling regrind plant and is further treated in the middling circuit. The scavenging plant is a later addition to the concentrator and has made a marked improvement in recovery by picking up attached particles of copper-iron mineral that would otherwise be lost, and also acting as a safety factor for unavoidable operating irregularities that occur in the preceding flotation.

All of the Minerals Separation Subaëration machines are belt-driven. They were made locally at Anyox and several have operated over a year without a shutdown for repairs. The impellers are made locally of cast white iron, and the average life is thirteen months. Power consumption of the Minerals Separation machines on a 4,800-ton per day basis is 1.95 kw.-hr. per ton. Very little trouble has been experienced with bevel gears and ball bearings, some of which have been used for more than three years.

The finished concentrate of the plant is dewatered in two 30-ft. rake type thickeners and one 60-ft. traction-type Dorr thickener, and filtered in three 8x12-ft. Oliver filters. The concentrate is then loaded into 25-ton railroad cars by conveyors, and after weighing taken to the sintering plant at the smelter.

In treating the Anyox heavy sulphide ores, the copper is liberated more readily from the pyrite than it is from the pyrrhotite. A finished concentrate is taken off and removed from the circuit and a low-grade secondary concentrate carrying the unreleased copper-iron sulphide is floated, dewatered, and reground to practically all through 200 mesh, and then treated in a separate circuit from the primary flotation. The reason for this is that often the liberated pyrite will float more readily than the attached copper-pyrrhotite mineral, and to make a satisfactory recovery by bulk flotation, before regrinding, would increase the volume of material to be reground and subject the already liberated copper to finer grinding, causing more difficulty in the subsequent selective separation.

Mill and classifier floor

Meeting the Demand In the Mining Industry For Technical Graduates

EDITORIAL COMMENT FROM SALT LAKE CITY

ALTHOUGH the registration in mining courses of the mining schools and universities of the United States has shown a slight increase, the total is far short of what it was ten, fifteen, or twenty years ago. The decrease has been explained as an effect of the law of supply and demand, but other reasons are also responsible. R. S. Lewis, professor of mining at the University of Utah, maintains that:

"Though offering high rewards to successful engineers, mining is at a disadvantage when compared with other lines of engineering. Many mining camps are quite comparable with small cities as far as living conditions are concerned, but others are not attractive places in which to live, being generally remote from centers of civilization, and often having severe climatic conditions. Again, married men are not usually considered as desirable as unmarried men, mainly because of the extra housing facilities that are required by the former. Educational facilities at many mining camps are usually poor, especially higher educational opportunities for older children. Many graduates in other lines of engineering find they can marry early and live where they can enjoy the advantages and opportunities offered by city life. They prefer to do this, even at a lower salary. College students are becoming familiar with these conditions. Mining as a profession is not making itself sufficiently attractive in surroundings, opportunity for advancement, and in salary to attract graduates in competition with the industries in other lines of engineering."

Dean Ketchum of the School of Mines and Engineering of the University of Utah avers that:

"Some of the most aggressive companies such as the General Electric, the Westinghouse Electric & Manufacturing, and the Du Pont, are building up powerful organizations by a carefully developed personnel system, whereby expert personnel officers scout the country each year, making investigations of prospective graduates in the various technical schools. These graduates, given a compensation sufficient to attract them into the organization, have exceptional opportunities to work in various departments and learn the various phases of the business. Not only have they an opportunity to learn the business, but these organizations are looking after these men by regulating their living conditions and giving them valuable technical and business instruction. As a result, the best of such learners are readily absorbed into the organization. The young men of today become the industrial powers of tomorrow.

"The metal-mining companies, the coal-mining companies, and the smelting companies should take more notice of this successful process that is helping to build up the great organizations of other industries. With the extremely keen competition in all lines of business at present, any industry which expects to be successful in the future must get its share of the most brilliant technically trained men, who will not 'line up' with ordinary employment seekers, to be treated as muckers and laborers. To be sure, these men are not valuable to the companies employing them when they are first employed; but, if handled in the manner indicated, they readily develop efficiency, especially when trained by the older men of the industry under actual working conditions."

The statements of Professor Lewis and Dean Ketchum, both of whom are actively connected with mining engineering education, explain the neglect of young men to take up mining and allied subjects as a profession as the fault of the mining industry, which fails to make mining engineering an attractive profession.

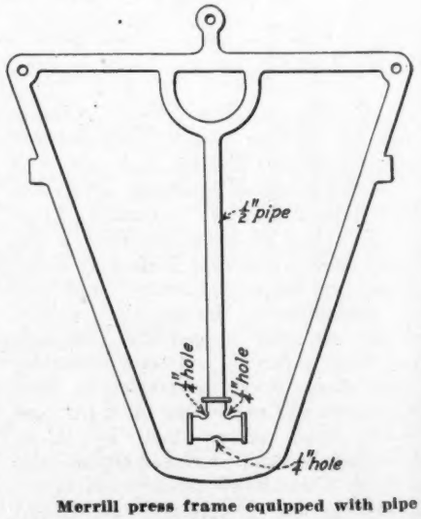
All engineering courses are fundamentally of the same nature, for, as has also been pointed out by Dean Ketchum, the business of the technical schools is to train young men in fundamentals, giving the best possible foundation in mathematics, science, and English that can be absorbed in four years, with a minimum amount of so-called practical training. The only value of practical work in engineering schools is to stimulate interest and to impress, by laboratory work, the ideas that are fundamental to the particular branch of engineering in which the practical work is given.

The mining profession should give more than passing thought to the suggestions of Professor Lewis and Dean Ketchum, for, as is well known, capable and courageous executives, supported by a thorough technically trained and loyal staff of officers, are necessary for normal success and expansion of any industrial enterprise. Experience has shown that a steady supply and careful selection of young university-trained men is necessary to keep an operating staff of a concern at a continuous high standard. If, therefore, industries other than mining can offer the young man the advantages of city life and better living conditions, the mining industry should carefully consider how it may meet this competition in so far as recruiting capable young men to its ranks is concerned.

Improving Merrill Press Precipitation

BETTER precipitation with the Merrill press was obtained at the Independence mill of the Portland Gold Mining Company, at Victor, Colo., by the use of a piece of pipe in the frame instead of the customary section of hose, writes G. C. Bush, of Central City, Colo.

As shown in the accompanying sketch, the improved arrangement consists of a T section attached to the end of a vertical piece of ½-in. pipe. The T section is drilled with ¼-in. holes in the center of each shoulder and at the bottom. A 2-in. clearance between the T section and the sides of the ring provides ample space for cleaning operations. The upward current caused by the flow through the 1.4-in. holes, as well as by that through the two open ends of the T section, prevents the cake from collecting in the bottom of the ring and aids in spreading the precipitate on the canvas. A saving in zinc and the production of a higher-grade precipitate and a tailing lower and more uniform in value were achieved by the use of the device.



Merrill press frame equipped with pipe device

Miami's Automatic Hoist

F. R. Grant

Industrial Engineering Department
General Electric Company

ABOUT five years ago the Miami Copper Company, Miami, Ariz., had practically exhausted its high-grade ore reserves and was confronted with the alternative of abandoning the mine or developing a more economical method of treating its low-grade ore, of which it had a large tonnage. After extensive experimentation, a system of mining and ore treatment which gave promise of yielding a profit was adopted. Economical handling of this low-grade ore was possible, however, only on the basis of a much larger daily tonnage than had been treated previously. To provide this tonnage a change was necessary in the hoisting equipment as well as in the concentrator.

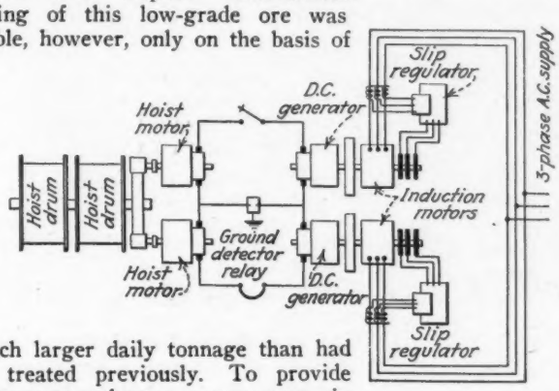


Fig. 1—Diagrammatic sketch of mechanical arrangement and power circuit of Miami Copper Company's automatic hoist

The hoisting equipment in use at this time operated on the system of control developed by Ilgner and Ward Leonard and consisted of a 1,400-hp., direct-current hoist motor geared to the drum, a 1,000-kw. flywheel motor-generator set driven by a slip-ring induction motor, a liquid slip regulator, and the necessary switchgear and manually operated control apparatus. This equipment had been supplied by the General Electric Company several years before and had been satisfactory for the tonnage then being hoisted.

A careful analysis of the hoisting problem with respect to the low-grade ore was made and decision was finally reached that the best way to take care of the required volume was to increase the hoisting speed to 2,250 ft. per minute and supplement the hoisting equipment by installing a duplicate motor and flywheel set, thus doubling the capacity of the electrical apparatus and making a 2,800-hp. hoist.

The mine is operated 24 hours per day and seven days per week, so that it is necessary to have three shifts of attendants, each consisting of two hoisting engineers and one station man per shift. Furthermore, in view of the rather narrow prospective margin of profit to be made on the low-grade ore, it was essential to reduce all operating expenses to a minimum. The company therefore decided to make the new hoisting equipment suitable for automatic operation, as are the hoists which have been in service for a number of years at the Inspiration Consolidated Copper Company's mines, adjoining the Miami Copper Company's property.

The new equipment and control was put into operation in July, 1929. Fig. 1 shows diagrammatically the mechanical arrangement and power circuit. Each hoist motor is direct-connected to a pinion mounted in its own bearings and engaging the main gear on the drum shaft. The two generators and two hoist motors are electrically connected in series through a circuit breaker and lever switch. A ground detector relay is connected between the motors and generators in such a way that the voltage to ground can never exceed the voltage generated by one unit. This relay is so arranged that a ground anywhere in the main power circuit will cause the circuit breaker to open, thus shutting down the equipment until the ground is found and removed.

Speed control of the flywheel sets is obtained by means of two slip regulators operating in conjunction with the induction motors which drive the sets. The torque motor of each regulator is connected in the primary circuit of its respective induction motor and it was possible by adjusting the counterweights on these regulators to obtain practically identical speed characteristics of the two sets under hoisting conditions.

Excitation for the generator and hoist motor fields is obtained from exciters direct-connected to the flywheel sets. Each exciter is of sufficient capacity to excite all four direct-current machines, but only one exciter is normally in use, the other being held as a spare unit. Voltage regulators are provided to maintain constant exciter voltage. Hoist motor fields are connected in multiple across the exciter with a small permanent resistor and an economy resistor in series. The economy resistor is short-circuited by a contactor while the hoist is in operation, but this contactor opens when the hoist is at rest, thus reducing the losses in the motor field to about 75 per cent of normal. Generator fields are also connected in parallel across the exciter through a variable resistance by means of which speed control of the hoist is obtained. The direction of rotation of the hoist is controlled by changing the polarity of the generator fields.

A drum controller was supplied for handling the generator field circuit and such other control circuits as were necessary for the desired automatic operation. This controller provides twenty speed-control points forward and reverse and has a lever for hand

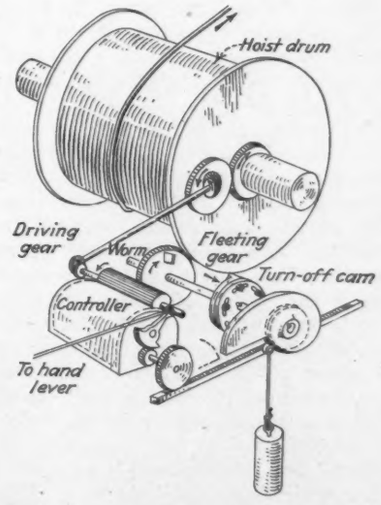


Fig. 2—Automatic controller turn-off device for electric mine hoists—Ward Leonard system

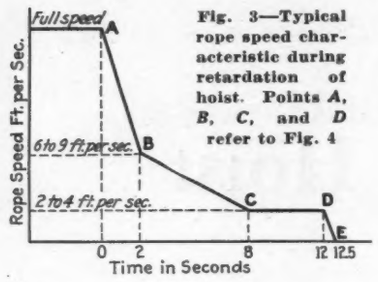


Fig. 3—Typical rope speed characteristic during retardation of hoist. Points *A*, *B*, *C*, and *D* refer to Fig. 4

operation as well as a pilot motor for automatic acceleration and a set of cams for automatic retardation. The pilot motor is connected to the controller by means of a magnetic clutch, a train of gears, and a chain. The clutch is wired in series with the pilot-motor armature, and so is energized only while the pilot motor is operating. The circuit of this motor is carried through a segment and finger of the controller which is so arranged that the motor is de-energized when the controller reaches the full-speed position. The same circuit is established through an "off" position contact in the controller, so that after the pilot motor has been de-energized, it cannot be again energized until the controller has been brought to the "off" position.

The direction of rotation of the pilot motor, which in turn determines the direction of movement of the controller and thereby the direction of rotation of the hoist, is controlled by a pair of reversing contactors. The coil circuits of these contactors are carried by a pair of geared limit switches driven from the hoist drums. Thus, in automatic operation, the direction of motion of the hoist is automatically determined and cannot be changed by the skip tender at the bottom of the shaft who starts the hoist.

In automatic operation the hoist is started by the skip tender at the loading station, who controls the mechanism for loading the skip. He is in a position, therefore, to start the hoist as soon as a skip is loaded. This operation consists of simply pulling a rope which closes a control switch momentarily. The switch then causes one of the reversing contactors for the pilot motor to close, after which the acceleration of the hoist is entirely automatic. The hoist will accelerate to full speed at a certain definite rate, depending on the speed of the pilot motor, and will then continue to run at full speed until a certain position in its travel is reached. It is then automatically retarded and finally brought to rest at the correct dumping position.

Retardation of the hoist is obtained by means of the cams in connection with the drum controller. These are geared directly to the hoist drums, and the connections of the generator fields and the movements of the controller are so co-ordinated that the cam which is geared to the drum on which the upcoming rope is wound will be in a position to return the controller to the "off" position, thus retarding the hoist. When these relations are once established, they will always remain correct, thus insuring that the controller will always be turned off at the proper time, regardless of the direction in which the hoist is moving. Fig. 2 shows diagrammatically the gearing and arrangement of such a cam mechanism. From this the reader will note that, as the drum rotates, it causes the fleeting gear to travel along the worm shaft until it engages the turn-off disk and causes the cam to rotate. As the latter turns, it forces the rack to the left, causing the controller cylinder to rotate to the "off" position. As the cam rotates, a weight hung on the camshaft is wound up, so that, at the beginning of the next trip, when the fleeting gear tends to back off, it will cause the cam to rotate in the opposite direction until it again reaches the position shown in the sketch. A duplicate arrangement is geared to the other drum, the cam of which will be effective during the next trip of the hoist.

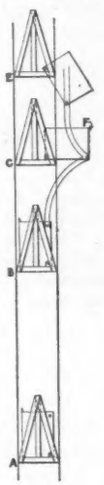


Fig. 4—Sketch showing skip at four points during retardation incidental to dumping. See Fig. 3.

The speed characteristic of the hoist during the retardation period can be varied by changing the shape of the cam. Fig. 3 shows a typical rope speed characteristic during retardation. Fig. 4 shows the corresponding position of the skip, and Fig. 5 the approximate shape of the cam to give the retardation curve of Fig. 3. At the point *A*, the hoist will be running at full speed and the cam will begin to rotate. At the point *B*, the skip is entering the curved dumping horns and the speed must be reduced to such a value that no appreciable shock is obtained. Otherwise, damage would be done to the horns or to the roller on the skip, and excessive maintenance would be necessary to keep the equipment functioning properly. Experience has shown that the speed at this point must not be over 9 ft. per second and it is preferable to have it somewhat less than this. At *C* the skip is in the horizontal position, at which point it must be transferred from the lower to the upper curved horns while it is pivoting about the auxiliary shaft *F*. At this point, the speed of the rope must be reduced to approximately 2 to 4 ft. per second. The skip then travels up the upper horns at this speed, which is practically constant, until the final dumping position *E* is reached, where the cam turns the controller into the "off" position, thus de-energizing the hoist generator field and applying the mechanical brake.

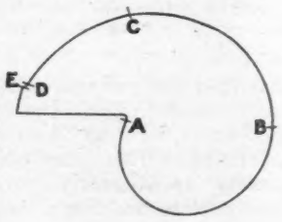


Fig. 5—Approximate shape of cam to give retardation curve of Fig. 3

The shape of the cams is different for every installation and must, therefore, be determined by actual experience when the equipment is started. Therefore, the cams are equipped with wooden blocks bolted to the spider, which makes it comparatively easy to cut and try until the proper shape is obtained, after which metal blocks, giving a permanent wearing surface, are substituted for the wooden ones. Conditions affecting the shape of the cams are: the time allowed for retardation, the rope speed of the hoist, the distance the rope travels while the skip is passing through the dumping horns, the speed at which it is practical to have the skip enter the dumping horns, and the time characteristics of the generator field.

Four automatic hoists are now operating in the United States. Three are at the Inspiration company's mines, the fourth being the one here described. Besides these, there is a hoist in Butte, at one of the Anaconda company's mines, which is arranged for automatic operation, but, because of present hoisting practice, can not be operated automatically. However, it was adjusted and operated automatically when installed, and is ready to be converted at any time into an automatic hoist by simply throwing a transfer switch for the control circuits.

The Miami hoist operates at the highest rope speed and is the largest, in point of horsepower, of any automatic hoist in this country and, so far as is known, in the world.

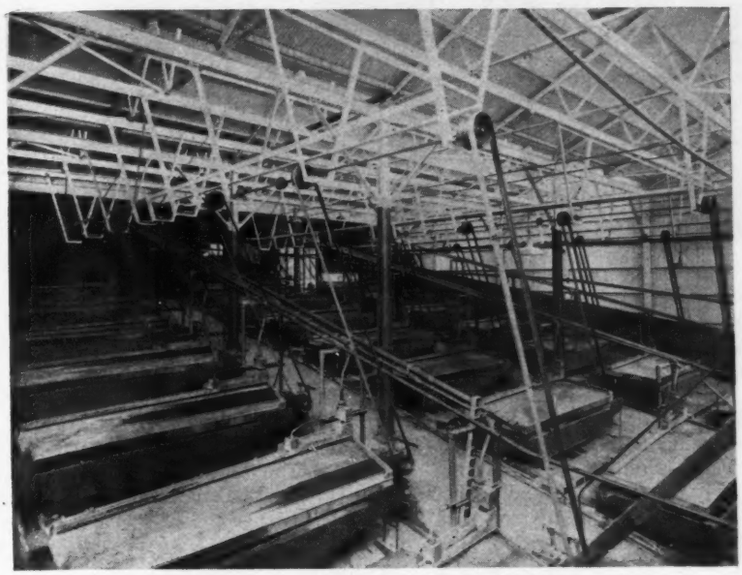
■

Costs at Miami Copper

A slight reduction in costs per pound of refined copper produced was made in 1929 at Miami Copper, operating in Arizona. Most of this decrease came from lower milling costs, as higher wages increased mining costs. Statistics of interest for 1928 and 1929 follow:

Per ton of ore:	1928	1929
Mining, cents	40.667	42.308
Milling, cents	38.176	35.913
General, cents	16.545	15.218
Per pound of copper:		
Total, cents	11.907	11.741
Mining	3.590	3.608
Milling	3.370	3.062
General	1.461	1.298
Pounds of copper per ton:		
In ore	17.06	16.60
Sulphide	13.14	13.70
Mill recovery	11.33	12.09
Copper production, tons	24,130	29,420

Metallurgical Practice at the Broken Hill South, New South Wales



A portion of the table department in the lead section of the South mill

BROKEN HILL SOUTH, LTD., is milling 7,000 long tons of crude ore per week of 128 hours at its property, situated at Broken Hill, New South Wales, Australia. The average ore milled assays 14 per cent lead, 5.0 oz. of silver per ton, and 11.5 per cent zinc. Quartz, quartzite, calcite, rhodonite, and garnet comprise the gangue minerals. A relatively large amount of the galena contained in the ore is present in a coarsely crystalline form, thus allowing a portion of it to be recovered by gravity processes.

The flow sheet of the South mill on the following page shows the treatment processes that have been adopted. The rolls are an improved Cornish type, 36 in. in diameter, with an 18-in. face. They are rotated at 16 r.p.m. and are operated in closed circuit with Type 39 Hum-mer screens. Each set of rolls crushes 20 tons per hour from 2 in. to minus 4 mm.

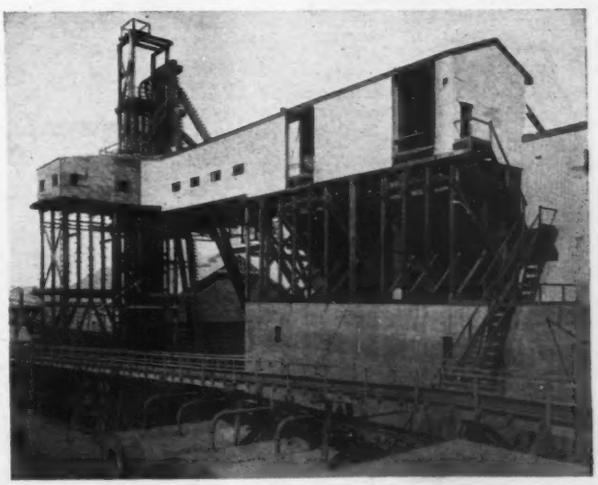
After desliming, the screen product is jigged. May Bros. Duplex jigs are used, and on these clean, free galena is recovered. Tailing from the jigs, after dewatering in classifiers, is ground in ball mills to a size suitable for subsequent zinc flotation treatment, as well as to leave a fair proportion of the galena in a form suitable for recovery by tables. Screen analyses of feed and discharge of these mills, crushing at the rate of 15 tons per hour, are shown in Table I.

Discharge from the ball mills, together with the slime overflow of the drag classifier ahead of the ball mills, is pumped to a four-way distributor and delivered evenly to four 54-in. x 18-ft. Model C20 Dorr classifiers for desliming prior to tabling. Overflows of the classifiers carry an evenly sized slime and fine sand, which pass to the differential lead flotation section. Each of the Dorr classifiers discharges to a seven-way distributor for distribution to seven South Mine type tables—28 in all—which produce a lead concentrate, lead middling, and a table tailing. The lead concentrate is pumped to the American filter plant, where it is joined by the flotation lead concentrate and dewatered. The table middling is delivered to distributors at the head of the Dorr classifiers and returned over the tables. Tailing from the tables is pumped to the dewatering drag classifier at the zinc plant for dewatering, prior to being mixed with de-leaded residues from the differential lead-flotation machines.

Table I—Screen Analyses of Ball Mill Feed and Discharge

Screen		Feed	Discharge
I. M. M. Mesh	Aperture in Mm.	Per Cent by Weight	Per Cent by Weight
30	0.421	52.7	3.9
40	0.317	9.8	5.9
60	0.211	11.3	12.4
80	0.157	11.0	18.6
120	0.107	3.0	5.8
200	0.063	8.0	21.8
— 200	.....	4.2	31.6
		100.0	100.0

The differential lead-flotation plant operates on the slime portion of the ore, which amounts to 40 per cent of



The 1,470-ft. ore-hoisting shaft and the crude-ore bins at the South mine

The data, flow sheet, and illustrations presented herewith have been made available and are published herewith through the courtesy of Mr. W. E. Wainwright, general manager, Broken Hill South, Ltd.

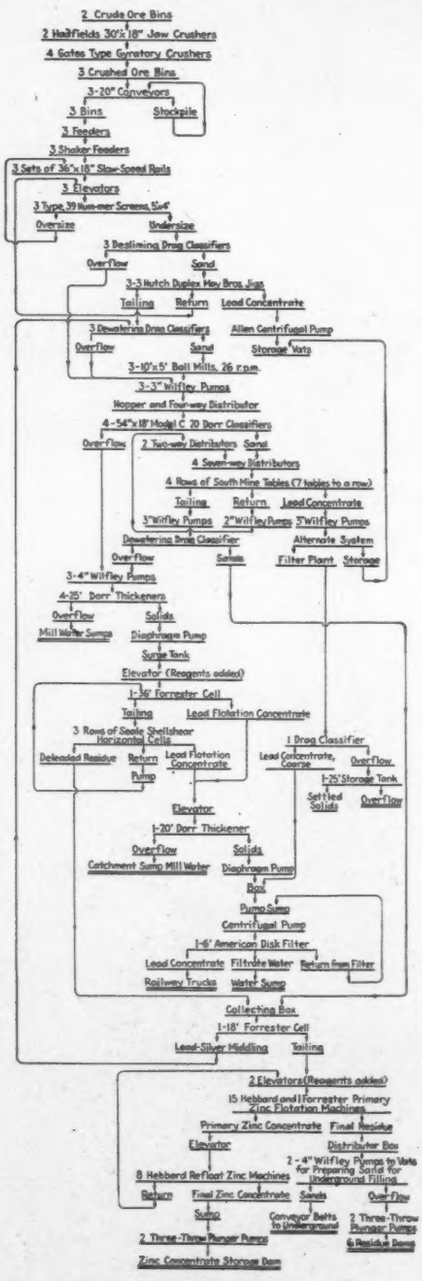
Table II—Analyses of Zinc Concentrate

M. M. Mesh	Per Cent by Weight	Assays: Per Cent Lead	Assays: Ounces of Silver per Ton	Assays: Per Cent Zinc
30	.....	...	...	...
40	1.5	2.9	2.4	43.2
60	9.9	3.4	2.4	51.2
80	16.7	3.4	3.0	50.3
120	3.1	2.8	2.2	50.2
200	20.1	1.8	1.2	51.2
200	48.7	2.2	1.2	49.2
	100.0	2.5	1.7	49.9

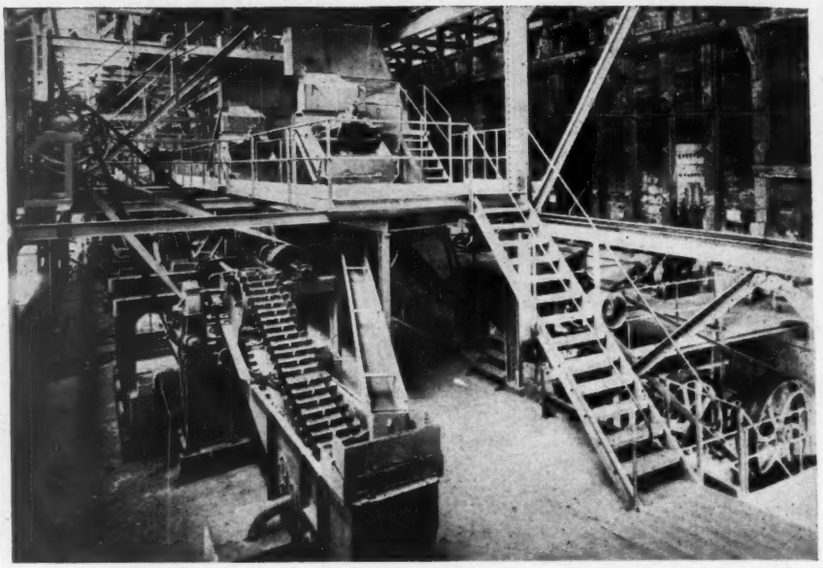
the crude ore. A finished flotation lead concentrate and a de-leaded residue are produced by the plants. The cleanness of this separation is evident on studying Table III-A. Seale-Shellshear horizontal flotation machines are largely used for this work.

The de-leaded residue joins the dewatered table tailing and passes through an 18-ft. Forrester cell, which acts as a scavenging machine, floating out the last of the free lead and silver minerals. After the pulp has passed through the scavenging machine, the zinc flotation reagents are added, and the pulp passes to a Hebbard Sub A under-driven machine. Fifteen Hebbard cells, followed by one 18-ft. Forrester cell, are used for primary zinc flotation, the concentrate from the primary section being refloated in eight Hebbard Sub A cells. The separation made by these machines is shown in Table III-B, and analyses of the zinc concentrate are given in Table II.

Residue from the zinc section, after draining in vats, is used for underground filling. All the principal products are machine sampled by cutting the pulp stream every ten minutes. Power required for the entire plant is 21.7 kw. per ton of crude ore. Metallurgical results of the plant are presented in Table III-C. The quantities of flotation reagents used per ton of ore are shown in Table IV.



Flow sheet of the Broken Hill South mill



Some of the rolls, Hum-mer screens, and May jigs used in the South mill

Table IV—Reagent Consumption

	Differential Lead Section	Zinc Section	Pounds per Ton of Crude Ore
Sulphuric acid	....	22.28	17.82
Copper sulphate	....	.724	.579
Sodium silicate	.957	.....	.383
Eucalyptus oil	.102	.608	.533
Coal tar distillate	....	.163	.130
Xanthate	.041	.091	.089

Table III-A—Differential Lead Flotation Section

(For twelve months ended June 30, 1929)

	Tons	Per Cent by Weight	Assay: Per Cent Lead	Assay: Ounces of Silver per Ton	Assay: Per Cent Zinc	Proportion of Metals: P Cent Lead	Proportion of Metals: Per Cen Silver	Proportion of Metals: Per Cent Zinc
Flotation lead concentrate	22,185	17.4	63.8	37.8	7.8	92.2	93.9	10.7
De-leaded residue	105,394	82.6	1.1	0.5	13.6	7.8	6.1	89.3
Feed	127,579	100.0	12.0	7.0	12.6	100.0	100.0	100.0

Table III-B—Zinc Flotation Section

(For twelve months ended June 30, 1929)

	Tons	Per Cent by Weight	Assay: Per Cent Lead	Assay: Ounces of Silver per Ton	Assay: Per Cent Zinc	Proportion of Metals: Per Cent Lead	Proportion of Metals: Per Cent Silver	Proportion of Metals: Per Cent Zinc
Zinc concentrate	60,541	23.8	2.4	1.7	49.6	51.3	58.5	92.6
Residue	194,104	76.2	0.7	0.4	1.2	48.7	41.5	7.4
Feed	254,654	100.0	1.1	0.7	12.7	100.0	100.0	100.0

Table III-C—Mill Recovery Statement

(For twelve months ended June 30, 1929)

	Tons	Per Cent by Weight	Assay: Per Cent Lead	Assay: Ounces of Silver per Ton	Assay: Per Cent Zinc	Proportion of Metals: Per Cent Lead	Proportion of Metals: Per Cent Silver	Proportion of Metals: Per Cent Zinc
Jig lead concentrate	24,515	7.7	69.1	18.8	5.2	37.3	25.2	3.5
Table lead concentrate	17,355	5.4	66.7	20.9	6.6	25.4	19.7	3.1
Flotation lead concentrate	22,185	7.0	63.8	37.8	7.8	31.1	45.6	4.7
Total	64,055	20.1	66.6	26.0	6.4	93.8	90.5	11.3
Zinc concentrate	60,541	19.0	2.4	1.7	49 6	3.2	5.6	82.2
Final residue	194,104	60.9	0.7	0.4	1.2	3.0	3.9	6.5
Feed	318,700	100.0	14.3	5.8	11.5	100.0	100.0	100.0

FLOTATION RESEARCH

on the Relative Activity of the Various Constituents of Crude Cresylic Acid

George L. Landolt, E. G. Hill, and Alexander Lowy

Departments of Metallurgy and Chemistry
University of Pittsburgh, Pennsylvania

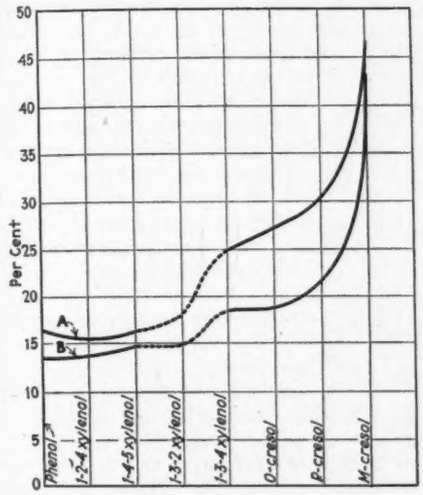


Fig. 1—Percentage of lead in concentrate, using various constituents of cresylic acid as flotation reagents. A, with 0.02 lb. potassium xanthate per ton; B, without collecting agent.

PHENOLIC ACIDS were known to have flotation properties as long ago as 1904, and since 1911 about a dozen patents have been granted for the use of cresylic acid and other hydroxy-aromatic compounds as flotation agents. Nevertheless, the literature on the subject is meager, and little has been known as to why crude cresylic acid had valuable properties. The term, like the term "carbolic acid," is a broad one. Commercially, crude cresylic acid is that fraction of a primary tar distilling between 190 and 230 deg. C., but analyses show that the concentrations of compounds found in many types from different sources vary widely even within this distillation range. The investigation herein reported was an effort to find which of the various constituents of commercial cresylic acid were responsible for its flotative properties; and to ascertain the relative floatabilities of those components that were effective.

The various inorganic reagents used were employed in concentrations similar to those of common practice, and in accordance with the standard laboratory practice worked out by Howard[1], the following concentrations per ton of ore were decided upon: 3 lb. soda ash; 0.5 lb. sodium cyanide; 1.5 lb. zinc sulphate; and 2 lb. copper sulphate. It was decided to use 0.02 lb. of potassium xanthate per ton of ore when an additional collector was included in the tests, because that amount is large enough to enrich the concentrate considerably, but still small enough so that the grade of concentrates floated would give a good measure of the floating powers of the other reagents. As the grade varied little with time of agitation, it was decided to stir for five-minute intervals each time after adding reagents.

To afford some basis of comparison for the different activities of the reagents tested, G.N.S. cresylic acid was taken as the standard, using 1, 2, 3, and 5 drops for charges of 500 grams of ore. Analyses were made of the lead concentrate to determine the relation of grade of concentrate to concentration of reagent. From the results given in Table I, it was decided to use

Table I—Per Cent of Lead in Concentrate with Various Concentrations of Reagent

Drops of Reagent	Per Cent Lead
1	12.1
2	14.6
3	16.1
4	16.4

exactly 0.05 grams (about three drops) for each trial on 500 grams of ore, which is 0.2 lb. per ton of ore.

Stirring continued for five minutes after adding the depressing agents; the G.N.S. cresylic acid was then added in varying quantities, stirring carried on for another five minutes, and the pulp then floated.

After determining optimum standard conditions, tests were made using the various constituents of cresylic acid as frothers and as frother-collectors, the results for lead being shown in Fig. 1 and for zinc in Fig. 2. In using 1-3-2 xylenol, three times as much was taken as the other reagents; as conditions were thus different to this extent, the curve is here shown dotted. Comparison and study of Figs. 1 and 2 show that similar results were obtained both with and without potassium xanthate so far as the relative action of the various components of cresylic acid is concerned. The order of activity of the reagents is also made plain. The use of meta-cresol decidedly increases the percentages of both lead and zinc in the concentrate, especially lead. Of the xylenols, the 1-3-4 was decidedly the best for lead, the others having about the same effect as phenol. This was to be expected, as it is the least soluble of the xylenols.

Table 2—Relative Floating Powers on Lead Ore of Some Different Types of Phenolic Acid

Reagent	Per Cent Lead When Using 0.02 Lb. of Potassium Xanthate	Per Cent Lead Without Potassium Xanthate
Cresylic acid (*a*)	20.05	16.5
Cresylic acid (*b*)	23.9	18.8
Cresylic acid (*c*)	19.8	16.1
U.S.P. cresol (*d*)	24.2	19.8
Propyl phenol (*e*)	31.04	24.1
Pine oil (*f*)	18.13	....

For references, see Table 3.

Three different grades of crude cresylic acid were tested with and without potassium xanthate. These results are given in Tables 2 and 3. The

[1]Howard, L. O.: "Selective Flotation and Its Relation to Metallurgy." *The Black Hills Engineer*, Jan., 1927, p. 27.

results using pine oil in place of cresylic acid, with potassium xanthate, were obtained for comparison. A mixture of propyl phenols, mostly ortho, was also tested, the results showing that it is better than either ortho- or para-cresol.

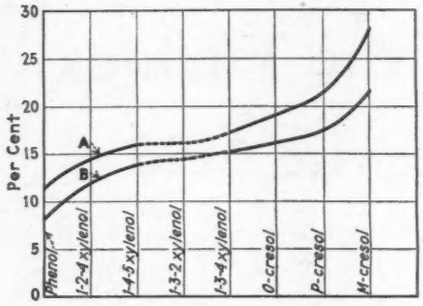


Fig. 2—Percentage of zinc in concentrate. A, with 0.02 lb. xanthate; B, without xanthate.

A crude cresylic acid was fractionated and the various fractions were tested for their relative value as frothers and frother - collectors, with the following results:

Fractions	Average Per Cent Lead in Concentrate Without Xanthate	Per Cent Lead in Concentrate With 0.02 Lb. Xanthate
1	18.5	23.1
2	15.5	17.2
3	17.4	20.4
4	18.8	23.5
5	15.5	17.2

The cresylic acid used was Barrett's crude cresylic acid, 97-99 per cent, straw color, distilling 50 per cent at 212 deg. C., containing a small amount of phenol, 30 to 40 per cent cresols, and the remainder mostly if not all xylenols. Fraction 1 contained everything that distilled below 207 deg. The major part of the cresols would be in this fraction, as they all boil below 203 deg. Fraction 2 contained all the residue, mostly xylenols, their boiling points ranging from 211½ to 225 deg. Fraction 3 was obtained from redistilling Fraction 1, being that part that distilled below 195 deg. All the phenol, B. P. 182 deg., and the ortho-cresol, B. P. 190 deg., would be in this fraction. Fraction 4 was the residue after distilling Fraction 3. This would contain meta- and para-cresols, B. P. 202.8 and 201.1 deg. respectively. Fraction 5 was the volatile portion of Fraction 2 after re-distillation, leaving a slight tarry residue. This fraction was a mixture of xylenols. From the foregoing data it is evident that the fraction containing the meta- and para-cresols was the most effective. Since the boiling points of meta- and para-cresols are so near each other, they could not be separated by fractional distillation.

Table 3—Relative Floating Powers on Zinc Ore

Reagent	Per Cent Zinc When Using 0.02 Lb. of Potassium Xanthate	Per Cent Zinc Without Potassium Xanthate
Cresylic acid (*a*)	17.21	14.71
Cresylic acid (*b*)	18.01	15.27
Cresylic acid (*c*)	15.54	14.12
U.S.P. cresol (*d*)	19.4	17.4
Pine oil (*f*)	16.09	.....

(*a*) Barrett's cresylic acid distilling 50 per cent at 212 deg. C.
(*b*) Barrett's cresylic acid distilling 50 per cent at 207 deg. C.
(*c*) General Naval Stores cresylic acid No. 29.
(*d*) Barrett Company (contains practically no xylenols).
(*e*) A mixture of ortho- and para-propyl phenol.
(*f*) Included for comparison.

Relative Activities of Some Additional Compounds

The following compounds, more or less soluble, were tried as flotation agents on a galena ore, but without success: catechol, quinol, resorcinol, orcinol, n-propyl resorcinol, n-butyl resorcinol, n-amyl resorcinol, iso-amyl resorcinol, and iso-hexyl resorcinol. They were tested to ascertain the effect when two hydroxyl groups were attached to the benzene ring.

The inactivity of catechol, quinol, and resorcinol was probably due to the lack of a water-repelling group in the molecule. In the cases of orcinol, n-propyl resorcinol, n-butyl resorcinol, and n-amyl resorcinol, the length of the side-chain was probably overbalanced by the two water-avid hydroxyl groups.

Branched hydrocarbon side-chains are not as effective as straight chains if the results shown in Table 4, using iso-hexyl resorcinol and n-hexyl resorcinol, are indicative of their behavior.

These figures indicate the necessity of a long water-repelling side-chain to offset the increased water-avid power of the two hydroxyl groups on the benzene ring.

Table 4—Relative Floatabilities of Some Di-hydroxy Phenols

Reagent	Lead in Concentrate Using No Xanthate Per Cent	Lead in Concentrate Using 0.02 Lb. Xanthate, Per Cent
Iso-hexyl resorcinol	No froth produced	No froth produced
N-hexyl resorcinol	14.9	17.2
N-octyl resorcinol	24.5	28.1
N-nonyl resorcinol	29.3	33.4

Summary

A study of the relative activities of the various constituents of crude cresylic acid, when used as frothing and collecting agents in floating a lead-zinc ore, showed that the cresols as a body were better than the xylenols, but the degree of activity depends greatly upon the position of the groups on the benzene ring for each group isomers. The decreasing order of the activity of these constituents was found to be: meta-, para-, ortho-cresol; 1-3-4 xylenol, 1-4-5 xylenol, 1-2-4 xylenol, phenol, and 1-3-2 xylenol. Experiments with three grades of crude cresylic acids, containing different ratios of cresols and xylenols, have shown that the cresols are superior to the xylenols when equal volumes are used. Propyl phenol, though not a constituent of cresylic acid in any quantity, was found to be a better agent than either ortho- or para-cresol.

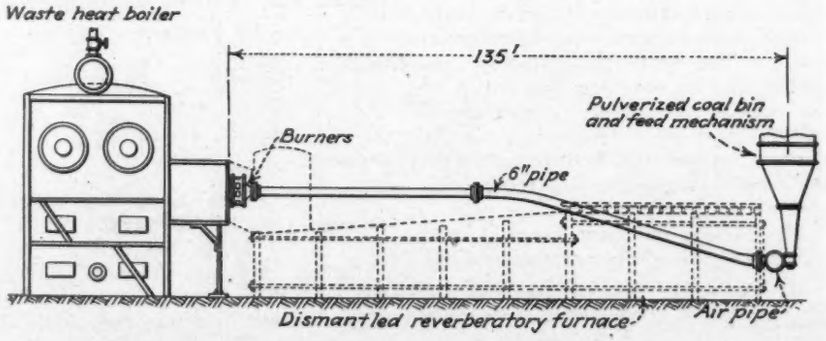
From the results obtained in this work, the value of crude cresylic acid as a frothing and collecting agent for galena or sphalerite depends apparently to a large extent upon the proportion of meta-cresol which it contains, and therefore, upon its source.

Waste-Heat Boiler Operation

AN INNOVATION at the A.S.&R. smelter, at Garfield, Utah, is the method of keeping a waste-heat boiler in operation after the reverberatory furnace has been dismantled.

All furnaces are fired by pulverized coal and have individual storage bins and a coal-feeding mechanism. Air for mixing and conveying the coal to the burners is obtained from a main air line. The removal of the aforementioned parts, with installation nearer to the waste-heat boiler, would have involved an expenditure of several thousand dollars. To avoid this expense, two burners were placed at the furnace end of the boiler and directly connected to the main air line and pulverized-coal feeder mechanism by two parallel 6-in. pipe lines, 135 ft. in length, as shown in the accompanying sketch.

Excellent results were obtained. Apart from the low cost of installation, considerable saving of air is also effected, only 13 to 14 oz. air pressure being required for operations.



COMPRESSED AIR CHART

Designed and Copyrighted by

Sydney C. Mifflen

THIS chart is based on D'Arcy's formula for the transmission of compressed air—

$$D = c\sqrt{\frac{d^5(p_1 - p_2)}{wL}}, \text{ where}$$

D = volume, in cubic feet per minute, of compressed air delivered at the final pressure;
c = a constant, depending on pipe diameter;
d = pipe diameter in inches;
p_1 = initial pressure in pounds per square inch;
p_2 = final pressure in pounds per square inch;
w = weight of 1 cu.ft. air at the initial pressure:
L = Length of pipe, in feet.

The chart is plotted for a length of pipe of 1,000 ft. Results for other lengths will be proportional.

EXAMPLE:

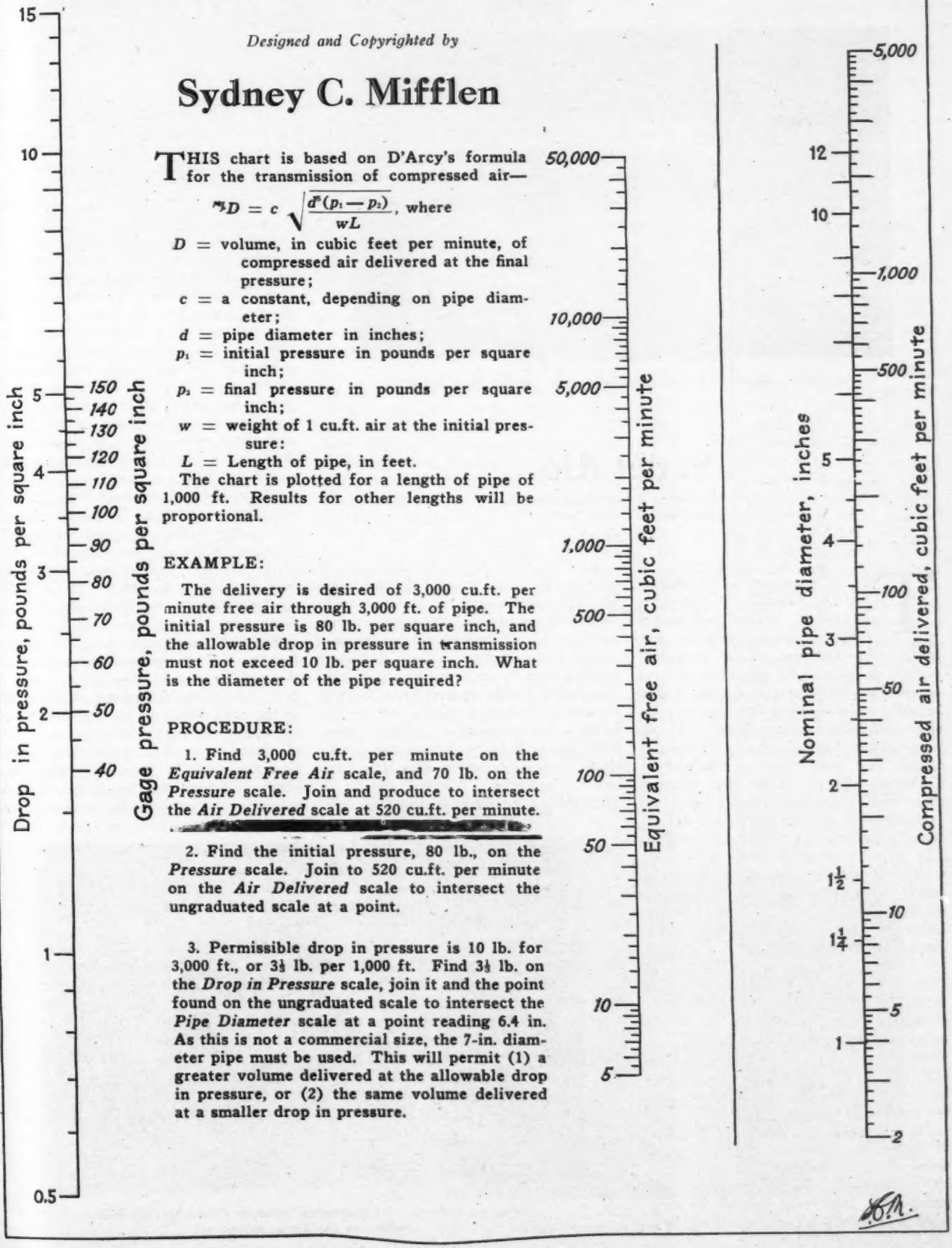
The delivery is desired of 3,000 cu.ft. per minute free air through 3,000 ft. of pipe. The initial pressure is 80 lb. per square inch, and the allowable drop in pressure in transmission must not exceed 10 lb. per square inch. What is the diameter of the pipe required?

PROCEDURE:

1. Find 3,000 cu.ft. per minute on the *Equivalent Free Air* scale, and 70 lb. on the *Pressure* scale. Join and produce to intersect the *Air Delivered* scale at 520 cu.ft. per minute.

2. Find the initial pressure, 80 lb., on the *Pressure* scale. Join to 520 cu.ft. per minute on the *Air Delivered* scale to intersect the ungraduated scale at a point.

3. Permissible drop in pressure is 10 lb. for 3,000 ft., or 3⅓ lb. per 1,000 ft. Find 3⅓ lb. on the *Drop in Pressure* scale, join it and the point found on the ungraduated scale to intersect the *Pipe Diameter* scale at a point reading 6.4 in. As this is not a commercial size, the 7-in. diameter pipe must be used. This will permit (1) a greater volume delivered at the allowable drop in pressure, or (2) the same volume delivered at a smaller drop in pressure.



Placer Mining in Colombia

Monitor operations at the Nudillales mine, on the Nare River

S. del Rio

Formerly Superintendent,
Hormiguero Mining Company

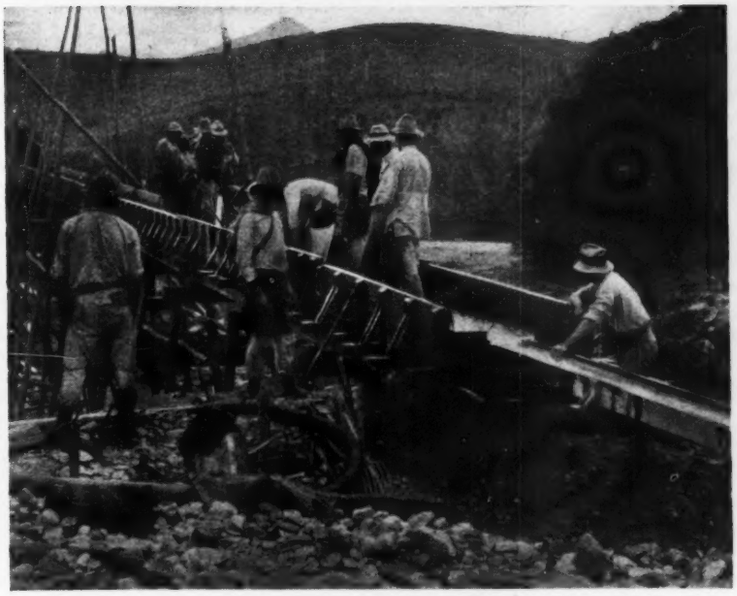
THE Department of Antioquia, in the Republic of Colombia, has been favored by nature. The climate is one more generally characteristic of a temperate region, in spite of the fact that the area composing Antioquia lies only a few hundred miles north of the Equator. Its rich gold placers have been a Mecca to a certain rugged type of American miners that have taken a foothold in Colombia and to whom that country owes most of its gold production.

Conditions in Antioquia are exceptionally favorable to hydraulic mining. The country abounds with waterfalls, which insure an all-year supply of power, although this fluctuates in intensity with the wet and dry seasons. Labor is efficient and cheap. A peon considers himself well paid if able to get $1.50 for twelve hours of strenuous labor. Transportation is good usually to within a few miles of the property chosen for exploitation, from which point equipment must be transported on mule-back. Food is plentiful but expensive. Living conditions can easily be made ideal. And, last but not least, the gold is there!

In general, the Andes Mountains of Antioquia consist of highly decomposed granite, occasionally interwoven by a network of quartz veins and stringers of auriferous pyrites, forming what is generally known as a stockwork. During the wet season, the torrential tropical rains slough down an incalculable tonnage of this soft bedrock, which carries with it considerable quantities of gold-bearing pyrite. This latter is worked over by the weather and further rain, being finally washed down to small streams and larger rivers, where still further disintegration takes place. After the gold is freed from the pyrite, placer formation commences in advantageous locations. Alluvial mining in Antioquia is generally adapted for elevator work, although a Brown dredge is at present under construction, to operate at the mouth of the Rio Grande where it runs into the Porce River—a location generally conceded to be a precarious one for a dredge by men familiar with local conditions. Another Brown dredge that had been operating on the Nus River was down some months ago, and at that time no decision as to whether it would be ordered to continue operation or be dismantled had been made. The dredges in the Pato district have been more fortunate, but the ground is nearing depletion. However, for the most part, the character of the river bottoms, the depth of the gravel bed, the relative quantity of large boulders, the rate of flow of the rivers and their susceptibility to floods make dredging a hazardous venture in most of the localities.

Nevertheless, hydraulicking is not without its setbacks in this region of fast-rising rivers. To one not actually engaged in the operation, the fact that, in spite of the years of experience, the responsible placer miners in Colombia are almost invariably flooded out at least once during the rainy season is difficult to comprehend. The reason for this lies in the circumstances that the regions around these mines, and, in fact, throughout the length and breadth of the watersheds of all the rivers and streams of the region, are almost devoid of timber. I have seen the Nare River rise five feet in something like two hours. Fortunately, this condition lasts only a few hours, or a day or so at most,

Sweeping bedrock with hand-hose streams at the Hormiguero mine, on the Porce River



Clean up at the Hormiguero mine

and though the losses may be quite disheartening, they are usually not irreparable.

Operation of these placers is usually preceded by a sampling of the ground. Sometimes, where the tenor of the gravel of an adjacent operating property up-river from the one under consideration is fairly well established, the owners or leasers may decide to begin equipping the property merely on the basis of known conditions. This is not as highly speculative a procedure as some might believe, for gold will probably be found, although perhaps not in paying quantities.

The bringing in of available water under head is the first consideration in equipping a property. A survey of the ditch line is made, giving it a slope of about one inch in ten feet. Ditches are built in trapezoidal cross-section, and are usually about 5 ft. across the top and 3½ or 4 ft. deep. The penstock or head-box is constructed of cement or wood, and is generally between 250 and 350 ft. above the level of the river. It has two gates, one for overflow and another for the main pipe line. This latter may be of 22-in. to 30-in. pipe, all depending on the number and size of the monitors and pumps to be operated.

The penstock or head-box has a wooden grate at its entrance, to remove flotsam which may injure the monitors or pumps below. An overflow gate is built in the main penstock or in a head-box, discharging into a pipe line or chute. Gates are provided to divert the water partly or wholly down the overflow or into the main pipe line. This latter is usually about 12 gage, and gives satisfactory results under a 300-ft. head. As the pipe is laid, the power it conveys is used to open roads, clear away the jungle, and level off by reducing the pipe to monitor size, attaching a monitor, and putting it to work.

When the pipe has been laid to location, a Y-connection is added, from which further extensions are made. The pump is gradually sunk with the help of the monitors, and mining operation starts with the erection of the flume and head-box. The purpose of the latter is to break the force of the stream from the pump and to localize splashing, thus preventing loss of gold.

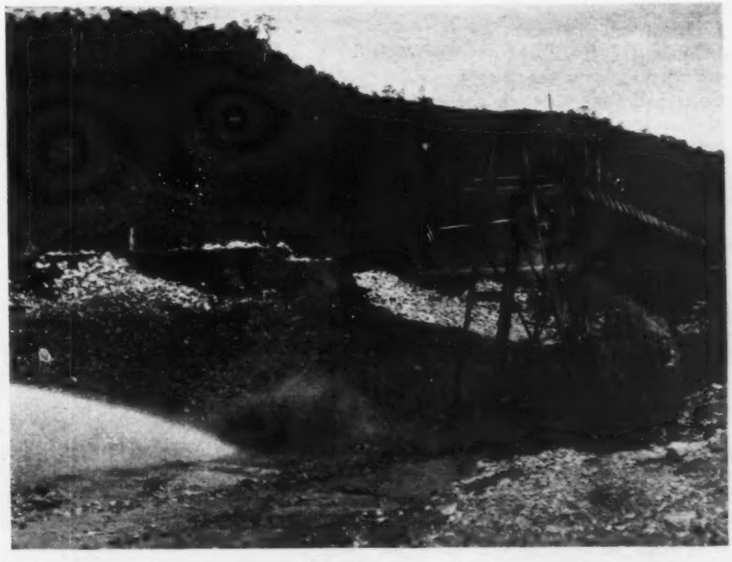
Risers from the pump enter the head-box through the floor at one end. The box itself is a closed-in affair on five sides, and usually is about 3x9 ft. and 6 ft. high. The sixth side, open, leads out onto the flume. The roof of this box directly over the stream from the pump is protected by thick manganese-steel liners. I suggest that massive rubber sheets, 2 or 3 in. thick, could be used here to advantage.

The flume may be 80 to 150 ft. long, although most of the gold is caught in the first few boxes of the group.

Some miners use undercurrents for catching the flake and flour gold. Mining a hole consists of pushing gravel toward the pump with the stream from the monitors, and allowing this to take it up and put it over the riffles, which are usually of the Hungarian type. The monitors are constantly being shifted about, as certain areas become mined out. In this the peons are expert. They also prove their real worth in moving aside the larger rocks and boulders that block up the smaller gravel.

When bedrock has been reached and all the larger gravel moved with the monitors, about six 3-in. hoses are brought out, and, with the peons swarming all over moving rocks, shutting and opening valves, and manning the hoses, the river bottom is swept clean. After this operation, all is ready for the clean-up. The riffles and side rods are taken out and washed carefully. However, at first a small flume about 30 ft. long and about 14 in. wide is attached to the tailing end of the larger flume, to catch gold that may be washed down. A hose is played on the gravel to loosen it and to allow the gold to work to the bottom. Then a hose is left running at the head of the flume. As the gravel is slowly worked back and forth by hand it is pushed toward the rail by the stream of water, the gold and black sand concentrating behind and being occasionally scooped into 5-gal. cans.

When most of the concentrate has been picked up, the remaining gravel is washed over the small flume, and the operation repeated in that flume. Finally the cans and their precious contents are marched to the mine-house on peon shoulders. Here old native hags, the best panners in the world, separate the gold from the black sand in wooden bateas in two washings, the first with water and the second with a slimy solution made by soaking pieces



Pump intake at the Nudillales mine

of alum-tree bark in water. The efficiency of this solution is almost miraculous. Finally, after drying the gold, it is given a last cleaning with an electromagnet. All the black sand and gravel that has been separated during the course of panning the concentrates is saved and the gold extracted by amalgamation or cyanidation when enough of this material has accumulated. The gold may vary in fineness from 800 to 900. As a rule it is of an easily settling character, being granular and heavy, although in certain localities, a high percentage of flaky and flour gold is included in the material under treatment.

Before closing I must mention Frank A. Anderson, manager of the Hormiguero Mining Company, under whose direction I had the pleasure to work. Mr. Anderson was attempting a tremendous task in making a cut one or two kilometers in length, into which he intended to turn the waters of the Porce River in order to mine its bed. He was greatly handicapped in this by the numerous boulders in his "patch," some of them of immense size. Experienced miners would come, take a look, shake their heads, and say, "He'll never do it. He'll need more powder to blast those 'doneys' out of his way than he'll ever be able to buy with ten Hormigueros." But Mr. Anderson fooled them. He knew that they were resting on soft bedrock, and he proceeded to sink "em out of sight." First he would play the monitor from one side and underneath, and then from the other. And the bigger they were the further down he drove them! Now the sullen Porce flows over these granite "cathedrals," and the experienced miners look on in wonder.

Profitable Amalgamation

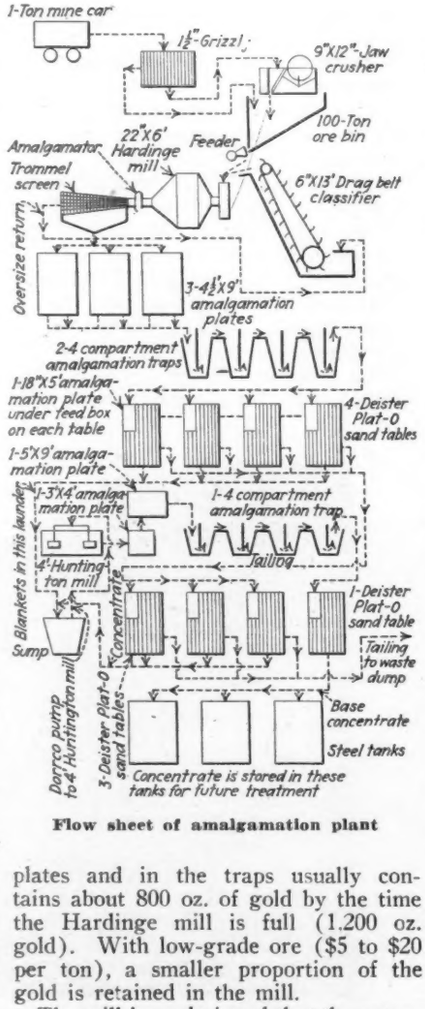
Clarence Woods

WHEN I came to Santo Domingo (Peru) in 1928 I found a few tons of ore and any sort of a mill I wanted. Stamps and plates had been used. In addition there were a complete all-slime cyanide plant, agitators, settlers, tanks, filter presses, flotation machines, amalgamation pans—in fact, all the latest gold-milling machinery. To figure out a method of milling which had not been tried took some time. Every effort had been a failure.

The ore is a typical vein quartz, carrying antimony (stibnite), iron pyrite, graphite, free gold, combined gold, quartz, and sometimes arsenical pyrites in a slate formation. Heads were from $10 to $20 per ton, with some bunches of "candle-box ore." The accompanying flow sheet was developed. It is the right one, for it pays.

The ore is ground in a 22-in.x6-ft. Hardinge conical mill with an excess of mercury, and the coarse material is returned to the mill by a drag classifier; the discharge goes to three sets of amalgamation plates. Control is maintained by carefully panning the discharge and watching the plates. When operations are first started, the greater part of the amalgam is retained in the mill, between the plates or under them, until about 1,200 oz. of gold has been caught inside. The amalgam thrown out of the mill is susceptible to plate amalgamation, and what escapes the plates is caught in two sets of amalgam traps or on copper plates under the feed boxes on the concentrators. In the concentrate launders from the tables to the Huntington mill are blankets, and these catch some amalgam. The concentrate is reground in the Huntington mill without the addition of more mercury.

Discharge from the Huntington mill is passed over a table. A concentrate, assaying about $100 per ton, is saved and stored in steel cyanide tanks for future treatment. The amalgam caught outside the Hardinge mill on the various



Flow sheet of amalgamation plant

plates and in the traps usually contains about 800 oz. of gold by the time the Hardinge mill is full (1,200 oz. gold). With low-grade ore ($5 to $20 per ton), a smaller proportion of the gold is retained in the mill.

The mill is so designed that the superintendent at his desk can see every amalgamation plate or trap, as well as the feed for the mill. We treat about 70 tons per day with a mill boss and five native workman per shift. The mercury loss is high; the tailing is high; the concentrate has too much money tied up in it; and stealing occurs. But the process pays. So from the mine owner's point of view the method is correct.

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Gold and Silver Production

WORLD gold production in 1928, according to the U. S. Mint statistics, totaled 19,674,638 oz., of which 4,734,414 oz. came from North America; 60,469 oz. from Central America and West Indies; 416,734 oz. from South America; 1,351,779 oz. from Europe; 1,202,887 oz. from Asia; 632,695 oz. from Oceania, and 11,275,660 oz. from Africa.

World silver production in 1928 totaled 257,273,490 oz., of which 188,899,718 oz. came from North America; 2,558,548 oz. from Central America and West Indies; 28,883,310 oz. from South America; 10,889,217 oz. from Europe; 14,468,420 oz. from Asia; 10,308,806 oz. from Oceania, and 1,265,411 oz. from Africa.

Total world gold production from 1493 to 1928 inclusive was 1,021,655,069 oz., or 35,029 tons, and total silver production was 14,467,232,012 oz., or 496,030 tons. The ratio of total silver production to gold production for the period is 14.16 to 1. Maximum annual gold production was 22,737,520 oz., in 1915, and maximum silver production was 257,273,490 oz., in 1928.

Mine Ventilation Systems on the Witwatersrand

AT A MEETING of the Empire Mining and Metallurgical Congress held at Johannesburg on March 31, Mr. A. J. Walton, general manager of Crown Mines, in an account of the ventilation system and conditions at that property, explained that the general scheme is to pass fresh air to the lowest connected levels and allow it to rise along the stope faces and raises to the upcast shafts. The stopes are worked by a modified shrinkage method, the hanging near the face being supported by broken ore which is removed and replaced by stone walls as the face advances. This arrangement causes a current of air to pass through all stope faces. All development drives are ventilated by galvanized-iron pipes, supplemented by canvas tubing, near to the faces, which is removed at blasting time. The air is propelled through these pipes by means of compressed-air jets in venturi pipes, or by small fans. Reef drives are placed at vertical distances of 150 ft. and are connected at intervals of approximately 600 ft. by raises, and the air currents are suitably split, so that a portion always passes to the last connection. The main haulages are usually 10 ft. wide by 10 ft. high and form main airways. These haulages are situated at vertical distances of about 900 ft. apart and are connected by small incline shafts at intervals of about 2,500 ft., placed below the reef, which form useful return airways through the worked-out areas.

At present the lowest level is the Level 41, at 6,556 ft. below the surface, and the average depth of stoping operations is about 4,000 ft. Little payable ore remains to be extracted above the Level 13, which is situated at a depth of 2,000 ft. The great benefit of a comparatively large number of upcast and downcast shafts is seen in the low pressure required to circulate the large quantity of air through the workings. It is calculated that the equivalent orifice for the whole mine with the present system of ventilation is 175 sq.ft., and that the average effective ventilating pressure required to pass 800,000 cu.ft. per minute through it is equivalent to 3 in. water gage, of which 1.3 in. is due to natural water gage during the average winter period.

Several propeller fans are in use. The blades are of the airplane-propeller type and are aluminum castings manufactured in the mine workshops. They fit into a cast-steel boss and can be adjusted on their axes so that the pitch may be varied in accordance with the mine requirements. To ascertain the most efficient number of blades and the best pitch at which to set them when running at a fixed speed under varying conditions of resistance, tests were carried out on an experimental fan at No. 16A shaft. This fan is 9 ft. 3 in. in diameter, and is direct-coupled to a 600-r.p.m. 100-hp. motor. The resistance consisted of an arrangement of doors which could be opened or closed to give areas of 25, 50, or 100 sq.ft. It was found that the efficiency of the fan improved as blades were added up to 32 blades, and that the lower pitches of 6, 7, and 8 ft. were better than the higher.

The ventilation system of Government Gold Mining Areas was described by R. A. H. Flugge-de Smidt, ventilation officer, Geduld Proprietary Mines, through the courtesy of the manager, Mr. H. Mitchell, and the ventilation officer, Mr. E. C. Polkinghorne, "as representing the best example of a well ventilated mine on the Far East Rand." The mine is ventilated by a 30-ft. diameter Walker fan at the top of No. 5 shaft, through which the vitiated air is exhausted from the workings. This shaft is 22 ft. in diameter, centrally situated in relation to the downcast shafts, and was sunk solely for ventilation purposes. A tandem compound engine of 1,500 hp. drives the fan, which is designed to pass 900,000 cu.ft. air per minute at a water gage of 7 in. At present the fan is operating at four-fifths of its full speed, and is handling about 800,000 cu.ft. air per minute (measured in the fan drift), the water gage being 4.5 in. The four producing shafts of the mine are rectangular and of seven compartments. These shafts are all downcast. Generally speaking, the policy on Government Areas is to concentrate as much of the cold downcast air as possible at the lowest points in the mine, after which it is split into the stopes and thence coursed through the intervening workings to the upcast shaft.

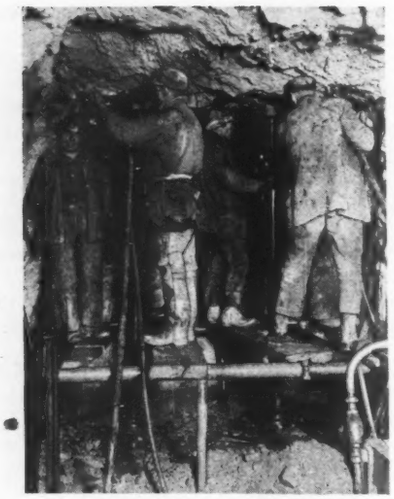
The following advantages may be claimed for this system: (1) The air reaches the extremities of the mine at temperatures between 6 deg. F. and 10 deg. F. lower than the rock temperature (although it may have traveled over a mile from the bottom of the downcast shaft), thus enabling the deepest working (rock temperature 84 deg. F.) to be kept reasonably cool; (2) the trend of natural ventilation is assisted, resulting in the greatest possible amount of air being circulated through the mine, because the air is allowed to rise as it gets warmer; (3) as a result of the concentration of large volumes, it is easier to obtain a definite movement of air along stope faces, so enhancing the cooling effect of the air on the workers, and providing for the dilution and removal of dust; (4) full effect is given to the condensation factor in the elimination of dust.

The system of footwall haulages for the transport of ore in use at this mine facilitates the operation of this method of ventilation. The main haulages are usually over 100 sq.ft. in area, straight, almost all of them well in the footwall of the reef, and tapped only by footwall crosscuts about 800 ft. apart.

Reduction in the incidence of silicosis during recent years is held to be due to a great extent to the improved methods of ventilation and dust control described, and it is probable that continued efforts in the same direction will improve the position still further.

The auxiliary ventilation system was also described and a plea was made for the standardization throughout the British Empire of terms and methods of testing the efficiency of mine fans.

Chain Screen Advantageous in Tunnel Blasting—Drilling Platform Speeds Work



This drilling platform is quickly erected

IN DRIVING the Hooper tunnel for the Bunker Hill & Sullivan Mining & Concentrating Company in the Kellogg (Idaho) district, J. Fred Johnson, tunnel and shaft contractor, has devised a chain screen for controlling rocks thrown back from the face in blasting. It consists of ½-in. chain in about 6-ft. lengths. Each length is attached to a hook, which is hung over a short length of 30-lb. rail. The latter is suspended by chains from two eyebolts placed 40 ft. back from the face, as shown in the cut, and moved up every 30 ft. of advance. At first a crossbar was used for suspending the screen, but the effect of the blast was to "tie knots in the bar" and this scheme was abandoned. The eyebolt and chain-supported crossrail was then tried and proved successful. Mr. Johnson believes that 40-lb. rail would be better than 30-lb. rail.

The screen acts to slow down the rocks thrown by blasting and being free to swing escapes any great punishment. The rocks thrown are thus concentrated within a short distance of the face and all damage to air pipe, compressed air line, water pipe, and firing line is avoided. As will be noted in the cut all pipes are brought up close to the chain screen on the left-hand side of the adit. The firing circuit is shown on the right-hand side. The ventilating pipe can be advanced to a position which avoids the use of any canvas pipe.

In blasting, all of the six cut holes are blasted at once. The charge is 40 lb. of 60 per cent explosive. Rocks would be thrown to a distance of 400 ft. back from the face, but with the screen in use the rocks extend no further than 30 ft. beyond the screen. This screen not only protects the equipment but saves time in mucking out. In quartzite the best position of the screen has been found to be 40 to 70 ft. back from the face, but in softer formations it can be carried closer.

Another time-saving device used by Johnson is a drilling platform that can be erected quickly. The platform is supported by two pipe lengths, each of which is provided with a telescope section held in position by a clamp against the end of the larger diameter pipe. A short section of pipe to form a vertical leg is welded to this section. In erecting the platform, the pipe is placed in position with the larger end against the side wall. The telescope pipe is drawn out until it bears against the opposite side wall, the clamp tightened, and a wedge driven at one end. Two-inch planks are then thrown across.

The adit is 8x8 ft. in section and is at present about 1,200 ft. long. Ingersoll-Rand S-70 drills are used upon two vertical bars as shown. A Butler mucking machine is used also. No records have been attempted, but up to 16½ ft. per day has been made.

Chain screen in position for blasting. Compressed air line, water line and ventilating pipe on left; firing line on left

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Modernizing Old Equipment

AT THE Walker copper mine, near Spring Garden, Calif., improvements have been made in the haulage equipment used in the mine adit. The equipment consists of 3- and 5-ton cars, which were provided with solid-roller type bearings. These have all been replaced by Timken roller bearings. Certain improvements in practice followed. The first was lubrication. The old bearings were greased once a week and gave a good deal of trouble. The new bearings are greased once every three months. Alemite equipment using 5,000 lb. pressure is used for greasing. No trouble has been experienced thus far with it.

With the same electric locomotives, eleven-car trains are now hauled where formerly six-car trains were the rule. Some improvements have been made upon these locomotives. Pressed-steel rims are placed on the tractor wheels and give double the grip of the old chill-tread wheels. When tractor wheels have to be reconditioned they are placed in a gap lathe and turned up, with the result that they are restored to their former efficiency. Ball bearings have been placed upon the motors and Timken roller bearings on the main journals. Braking controllers have also been added and likewise sirens.

One of the main adit locomotives thus improved has been in operation eight months without giving trouble and is still in excellent condition. With the old equipment of solid bearings, when the motor bearings wore down the rotor would rub upon the stator and some of the coils would be "shorted," thus causing a rewind job, with consequent loss of time. Main journal bearings in the old layout caused a good deal of trouble. Locomotives are equipped with the usual bells, but the auxiliary siren has proved to be useful in giving shrill warning signals.

COMMENT AND CRITICISM

Power Costs and Charts

To the Editor of "E.&M.J.":

The charts for predicting power costs that accompanied the article "Power for the Mine and Mill" in the Jan. 9 issue are indeed convenient. Unfortunately, however, analysis indicates that they lack even the approximate accuracy needed for a preliminary power study. Economic studies of this character always are based on a large number of factors—too many to include in a few simple charts; consequently several definite assumptions have to be made before the charts are constructed. Whether the answers obtained from the charts will be correct for a certain set of conditions depends upon how nearly the chart assumptions are true for those conditions.

To consider the cost of oil engine power, for instance, the charts in the article will give, for most conditions, values that depart materially from results that would actually be obtained. These discrepancies result from the fact that some of the assumptions upon which the charts are based are not at all typical. For example, the chart of fixed charges is based on a rate of 18 per cent of plant cost per annum to cover amortization of the sum invested in the plant, interest on the investment, taxes, and insurance. This is generally far too heavy a charge, 12 per cent being a much more common figure. The life of an oil engine plant is at least twenty years. If interest is 6 per cent, the annual amortization charge for twenty years is 2.72 per cent. Taxes and insurance should not exceed 2 per cent, making a total of 10.72 per cent. Thus, fixed charges on oil engine plants are generally estimated by their owners at 10 to 12 per cent.

Even if the life of a mine is estimated at only ten years, the equipment has salvage value, and, for a Diesel power plant costing $150 per kilowatt, the salvage value at the end of ten years will be at least $40 per kilowatt. Reference to amortization tables will show that an annual charge of $8.35, or 5.57 per cent of $150, will in ten years amortize the $110 depreciation. Adding interest on the initial investment at 6 per cent, and allowing 2 per cent for taxes and insurance, the total fixed charge would be only 13.6 per cent.

Although the chart for the cost of oil fuel per kilowatt-hour covers a wide range of prices of oil per barrel, the author limits consideration to very high-priced oil by his statement that "no oil containing more than 0.25 per cent sulphur should be considered a satisfactory Diesel fuel." Accordingly, he chooses for his example a low sulphur Diesel oil of 24 deg. Bé., which he assumes to cost $5 per barrel, or 11.9c. per gallon. These are far from typical values. Sulphur is not at all the dangerous constituent of Diesel oil that it was once thought to be, and many Diesel engines are operating satisfactorily on oils with a much higher sulphur content. In fact, with the approval of the various Diesel engine manufacturers, the A.S.M.E. Research Committee on Diesel Fuel Oil Specifications is now specifying a limit of 3 per cent for sulphur. As regards the price of Diesel fuel, even after including all transportation charges to the Atlantic Seaboard, high-grade Diesel fuel oil of 32 deg. Bé. sells for less than 6c. per gallon in tank-car lots delivered. In the West, the price is, of course, much cheaper. For instance, a mine in Arizona is buying 28 deg. Bé. California fuel oil for its Diesel engines at 4.7c. per gallon delivered. Certainly in a location where 12,000 B.t.u. coal can be had for $2 per ton, as in the example cited by the author, a satisfactory Diesel fuel can be obtained for much less than $5 per barrel.

According to the chart, the labor cost in a 500-kw. oil-engine installation, operating at 40 per cent average annual capacity factor, would be 0.48c. per kilowatt-hour. This would result in a payroll of more than $160 per week. which is unusually high. Modern developments, employing automatic controls, permit Diesel plants of this size to be operated with only part-time attendance; but, even if the full time of one chief engineer at $50 per week and two shift engineers at $35 each is charged, the weekly payroll would be only $120.

In the article, the cost of lubrication and supplies is assumed at 0.2c. per kilowatt-hour, and the same value is assumed for maintenance. Reference to operating records of modern Diesel power plants shows that each of these items actually amounts to about half of that assumed.

In any particular instance, basic assumptions that do not agree with the actual facts will change the entire significance of the results. This is well illustrated by applying corrected basic assumptions to the oil-engine example used in the original article, which predicted a total power cost of 2.88c. per kilowatt-hour. With the same load requirements — that is, 500-kw. plant capacity and 40 per cent average annual capacity factor—the corrected estimate of Diesel engine power cost would be:

	Cost per Kilowatt-Hour, Cents
Fuel, $2.25 per barrel or 5.45c. per gallon	.55
Lubrication and supplies	.10
Repairs and maintenance	.10
Labor and administration, $120 per week	.36
Fixed charges, 12 per cent	.51
Total	1.62

According to this corrected estimate, the cost of Diesel power would be about 44 per cent less than that originally predicted, and about 18 per cent cheaper than the estimate for purchased power; a thorough study of a Diesel plant is justified.

The reasonableness of 1.62c. per kilowatt-hour for the total cost of Diesel power is substantiated by many actual records, such as that of a slightly larger Diesel plant in an Arizona copper mine, where the operating cost is 0.84c. per kilowatt-hour and the total cost, including fixed charges, only 1.21c.

I have found that the best way to deal with a specific power problem is to make a specialized study on the basis of the factors actually prevailing rather than to utilize curves, no matter how soundly such curves may have been constructed. The results are far more dependable.

EDGAR J. KATES,
Consulting Engineer.
New York, N. Y.

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Cost of Power in Mining Polyhalite

To the Editor of "E.&M.J.":

With reference to the publication, in the issue of March 24, of an abstract of my paper on "Domestic Potash," may I call your attention to an omission that may cause undeserved criticism of my cost figures.

The table of mining costs shows that the cost of power, per ton of polyhalite mined, is $0.018. Unless some explanation of this item is offered it certainly merits criticism, for every mine operator in the country knows that the 8 to 12 kw.-hr. required to deliver a ton of ore at the top of the shaft will cost him from

ten to fifteen times the amount of the item shown in the table you publish.

In this particular case the power for mine use is, in a sense, a "byproduct" of the treatment plant. Large quantities of low-pressure steam are required for the treatment of polyhalite. By slightly increasing the steam pressure and running the steam through a turbine, power for plant use is obtained at a very low figure. The turbine exhaust goes on to the treatment plant, where it is used in the treatment process and where most of the costs are allocated. Thus we get a very low power cost for mine power: about one-tenth the normal cost, if I remember correctly. Power plant estimates are given in full in the Bureau of Mines bulletin. JAMES S. WROTH.

Salt Lake City, Utah.

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Engineering Ethics and Promotion Practices

To the Editor of "E.&M.J.":

In the course of a recent conversation on professional ethics with an American mining engineer, he remarked: "The system is different with you English. Over on your side an engineer can apparently take part in promoting a mining company or project without incurring criticism; with us such acts are not considered ethical." To this I replied, "Now do you know? We were of the opinion that the boot was on the other foot. With us almost death and damnation is meted out to an engineer who is suspected of being connected with a promotion; but, with you, engagements of this character do not seem to arouse comment."

Let us see what are the facts. To avert criticism, I might add here that I was born in England, have lived about one-third of my life there, one-third in other parts of the world, and one-third in America. Moreover, I have worked as much with American engineers as with their English colleagues. The subject may be considered from two different aspects: (1) What is intrinsically right or ethical?; (2) what is considered so by the profession and the public, both here in the United States and in England?

Now, we shall assume that mining engineers, English and American, are honest and honorable. But they are human, and, like other humans, likely to be swayed by their emotions and feelings. Therefore, when one of them is financially interested in a property on which he is reporting, he is inclined to feel too favorably toward it, and write accordingly, or to lean backward in the other direction, and condemn it or perhaps "damn with faint praise." The more honest he is, and the better the property, and consequently the more favorably disposed he feels toward it, the more likely he is to suspect his own motives, and to qualify what would, in other circumstances, be a favorable report.

Such action would not be fair to his associates, and the too favorable report would not be fair to the public. The engineer should deal with facts, and so he does. But, on an ability to interpret facts, and to make prophecies and render opinions based on facts, is the reputation of the engineer established, especially that of the mining engineer. "It is difference of opinion that makes horse racing." It also makes, and unmakes, mining engineers. We can, therefore, say that from both the idealistic and scientific points of view the engineer should not be financially interested in a property on which he is rendering a report.

This may be, however, a counsel of perfection in this ordinary workaday world. Is it not possible, even allowing for some slight bias in either of the aforesaid directions, that the well-educated, experienced engineer can be sufficiently close to the truth for all practical purposes in his interpretations, opinions, and predictions, even though he is financially interested in the property? Probably many of us, perhaps most of us, can; our education tends to inculcate such ability. However, a minority probably cannot. This group includes the natural optimist and his pessimist countertype—men who are swayed more by their emotions than their brains, and those whose geese are invariably swans. The latter two types should not be engineers, certainly not mining engineers. What then can be suggested? Is a compromise possible that can be made with safety? I am inclined to think so.

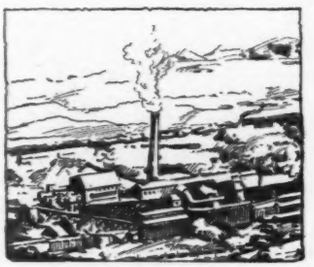
In the first place, a safe rule to adopt would be that no engineer should write *for publication* a report on a property in which he is financially interested or in which he is to become interested by reason of his report. This rule might be amended to permit publication of such a report if to it were appended a clear and definite statement that the writer was interested in the property to which it pertained. For several reasons this possible amendment does not appear on mature consideration to be advisable.

On the contrary, when an engineer is interested with a few friends in a property, or even if he is to be given an interest as compensation for his report, no reason why he should not make the report is apparent, provided it is kept private and not used for raising money or for any other promotional purpose. He is, of course, to some extent putting himself at the mercy of his associates, but that does not involve his personal ethics. I recognize that this is debatable, but it has been here advanced and emphasized partly to arouse debate.

The most debatable ground lies between the extremes outlined in the two preceding paragraphs. Is it legitimate for an engineer to become interested in a property, possibly to take part in the mechanics of its promotion, and to allow his signed report to appear in the prospectus? He has, perhaps, helped in the development of the mine from the prospect stage; he may even have discovered the property, know its entire history, and honestly believe its successful operation assured. Moreover, his opinion may be confirmed by other engineers. Nevertheless, to this question the answer of most of us on both sides of the Atlantic would be in the negative. And yet two of the most successful men in the profession have done just this, and have been awarded almost every possible honor not only outside the profession but in it.

The answer of the profession to our query is apparently that if you promote successfully, especially if you do it on a sufficiently large scale, "all right"; but if you fail, or if you do it on too small a scale, "all wrong." I am not wittingly attempting to be cynical, but rather trying—possibly somewhat desperately—to arrive at a legitimate conclusion and an ethical standard that may deservedly be acceptable to the profession.

Another debatable situation frequently arises when an engineer has financial connections who, he knows, wish to acquire a certain kind of property. He comes across such a property, possibly after deliberately looking for it. No reason is apparent why he should not write a report on the property and present it to his friends, irrespective of whether compensation for his work is in the form of cash or an interest in the property, should his connections decide to become financially interested in its exploitation.



Finally, the engineer may be definitely commissioned to find a certain type of mineral deposit. Regardless of whether his pay takes the form of cash or an interest in the property, when it has been acquired, he invariably must write a report for his principals before any business leading to the acquisition of the property can be transacted. But in such instances, too, he should stipulate that the report is confidential, and he should always so mark it.

Los Angeles. EDGAR BUSH.

Digest of Current Technical Literature

Selected from abstracts of articles in the leading technical periodicals, prepared by Engineering Index Service, American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y.

Feldspar Grinding Mills—New Feldspar Grinding Mill. H. J. Bryson. *Rock Products*, Vol. 32, No. 24, Nov. 23, 1929.

DESCRIPTION of electrically operated grinding mill of Feldspar Milling Company, Burnsville, N. C.—E.I.S., New York.

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Ore Treatment—Development of Ore-Treatment Technology in 1928. H. Madel. *Metall und Erz.* Vol. 26, No. 17, Sept. 1, 1929.

REVIEW of recent methods and equipment. —E.I.S., New York.

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Cableways — Aërial Ropeways. C. G. Ross. *Canadian Mining Journal.* Vol. 50, No. 48, Nov. 29, 1929.

EARLY use of cableways at mines; bicable and monocable types; examples of application.—E.I.S., New York.

•

Diesel Engines—Diesel Engines—Their Present and Possible Applications in Pit and Quarry Industries, J. O. Durkee. *Pit and Quarry.* Vol. 19, No. 4, Nov. 20, 1929.

PRACTICAL applications of oil engines and opportunities for savings by use of this power.—E.I.S., New York.

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Copper Smelting Plants, Montana — Anaconda Copper's Washoe Plant. R. H. Bradford. *Canadian Mining Journal* (Gardenvale, Que.), Vol. 51, No. 4, Jan. 24, 1930.

ACCOUNT describing principal features of plant and changes that have been made.—E.I.S., New York.

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Electric Locomotives, Mine—How to Keep Electric Locomotives Continuously on the Job. J. S. Dean. *Coal Age*, Vol. 34, Nos. 11 and 12, Nov. and Dec., 1929.

NOV.: First step is adequate equipment; inspection must be regular and thorough; motor armatures; motor frames. Dec.: Babbitting bearings; lubrication; electric welding; detail of electric equipment; mechanical parts.—E.I.S., New York.

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Copper Metallurgy—Progress in the Reduction and Refining of Copper, 1929. F. Laist. *Mining and Metallurgy*, Vol. 11, No. 277, Jan., 1930.

INTENSIVE study of reverberatory furnace smelting reveals no marked advantage from variations in feeding methods; solution purification method at Potrerillos is novelty.—E.I.S., New York.

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Electric Locomotives, Mine—Rationalization in Coal Mining and Underground Transportation; Importance of Storage-Battery Locomotives (Die Rationalisierung im Steinkohlenberg). J. Faust and W. Sauer. *Elektrizitaet im Bergbau* (Munich), Vol. 4, Nos. 10 and 11, Oct. 14, and Nov. 18, 1929.

OCT. 14: Statistical study of accidents in 1927, showing disadvantages of mechanical power; cost data of various types of haulage equipment; details of German makes of storage-battery locomotives. Nov. 18: Charging equipment for lead and Edison batteries with wiring diagrams and voltage curves of both types; costs and future possibilities of storage-battery haulage.—E.I.S., New York.

•

Grinding Mills—New Developments in the Field of Pebble Mill Grinding. H. F. Kleinfeldt. *Ceramic Age*, Vol. 14, No. 6, Dec., 1929; and discussion.

IMPORTANT features of construction and operation; suggestions for improved service; rubber-lined mills.—E.I.S., New York.

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Beryllium — Beryllium — Its Extraction and Its Alloys. *Heat Treating and Forging*, Vol. 15, No. 11, Nov., 1929.

PRESENT status of this metal is set forth with reference to its possible industrial applications. Translated from *Zeit. fuer die gesamte Giessereipraxis.* — E.I.S., New York.

•

Tin Dredging—Southern Malayan Tin Dredges. *Mining Magazine* (London), Vol. 41, No. 5, Nov., 1929.

PARTICULARS are given of large modern dredges designed for working extensive deposits of comparatively low-grade tin ground; jigs are embodied in design instead of sluice boxes.—E.I.S., New York.

•

Geophysical Exploration — Rules for Taking Samples During Exploratory Drilling for Geological Evaluation (Richtlinien fuer die Entnahme von Proben bei Bohrungen zum Zwecke ihrer geologischen Auswertung). *Petroleum* (Berlin), Vol. 25, No. 40, Oct. 2, 1929.

IT IS SUGGESTED that geologists should agree on certain terminology, such as coarse grain, fine grain, hard, soft, with regard to color and technical properties of rocks; exploratory drilling should be under geological control.—E.I.S., New York.

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Zinc-Ore Treatment: Roasting—Super-roasting of Zinc Blende by Different Methods, E. Prost. *Revue Universelle des Mines.* Vol. 72, Nos. 8 and 9, Oct. 15, and Nov. 1, 1929.

OCT. 15: Super-roasting of blende considered important step in dry metallurgy of zinc; typical ores of zinc; equipment and practice at Bartlesville, Okla., and Baelen, Belgium. Nov. 1: Plant and practice at Compagnie des Métaux et Produits chimiques d'Overpelt, Lommel, Corphalie; results obtained at Compagnie des Métaux and Overpelt; super-roasting process at Engis; products obtained.—E.I.S., New York.

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Gold Ore Treatment: Amalgamation (Davidson Process) — The Davidson Recovery Process. G. P. Davidson. *Min. and Indus. Mag. of S. Africa* (Johannesburg), Vol. 9, Nos. 4, 5, 6, and 7, Oct. 16 and 30, Nov. 13 and 27, 1929.

OCT. 16: Editorial describes demonstration plant as tank over mixing box, small amalgamating plate, and short launder covered with corduroy; heads 25.2 and tailings 6.3 dwt. gold. Oct. 30: Anonymous criticism questions novelty; if claims can be justified, process might lead to profitable mining on Black Reef. Nov. 13: Editorial expresses skepticism. Nov. 27: Davidson replies; objects to unfair treatment and omissions in description; process developed during 24 years and not claimed as new; no patent applied for.—E.I.S., New York.

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Diamond Mines and Mining: Gold Coast, Africa—Diamond Mining on the Gold Coast. S. V. Griffith. *Mining Magazine* (London), Vol. 41, No. 5, Nov., 1929.

AUTHOR describes occurrence of diamonds in Gold Coast Colony and gives particulars of prospecting method and mining and extraction of diamonds.—E.I.S., New York.

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Lead Mines and Mining, Idaho—Mining Practice at Bunker Hill & Sullivan. U. E. Brown. *Mining Congress Journal*, Vol. 16, No. 1, Jan., 1930.

METHOD of mining designed to secure complete recovery of ore; safety as major factor; complete description of method employed and results obtained.—E.I.S., New York.

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Excavating Machinery — Small-Size Shovel Excavators (Verwendung kleiner Loeffelbagger in schweren Bodenarten). K. Weissemmel. *Tonindustrie Zeit.* (Berlin), Vol. 53, No. 80, Oct. 7, 1929.

TESTS have shown that small shovel excavators (about ¾-cu.yd. capacity) used alone give good results with heavy material; grabbing power is developed mainly by lifting apparatus and varies considerably in windlass strength, depending on position of shovel.—E.I.S., New York.

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Lead-Zinc Ore Treatment (Flotation) Australia—The Mill and Smelter at Mount Isa. J. M. Callow. *Mining Magazine* (London), Vol. 41, No. 6, Dec., 1929.

CONSULTING metallurgist to Mount Isa Mines, Ltd., gives account of concentrator and metallurgical plant now in course of erection at property in northwestern Queensland.—E.I.S., New York.

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Beryllium, New Jersey—On the Occurrence of Beryllium in the Zinc Deposits of Franklin, New Jersey. C. Palache and L. H. Bauer. *American Mineralogist*, Vol. 15, No. 1, Jan., 1930.

NOTE on discovery of presence of beryllium in crystals of complex silicate; found later in another mineral in same locality; regarded as of interest, in view of search for beryllium ores, but minerals occur in veins of moderate extent.—E.I.S., New York.

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Cadmium—Cadmium: Its Character and Uses. F. M. Wichman. *Mining Review*, Vol. 31, No. 15, Nov. 15, 1929.

NOTE on history of mineral occurrence; chief source is sulphide and carbonate, associated with zinc minerals; uses of cadmium metal; recovery process, as practiced at Midvale Plant of United States Smelt-

ing, Refining & Mining Company in Utah, where cadmium has been produced for fourteen years.—E.I.S., New York.

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Copper Smelting, Spain — Present-Day Smelting Practice at Rio Tinto and Notes on Converting Low Grade Matte at Rio Tinto. H. R. Potts. *Instn. of Min. and Met.*, Bul. No. 302, Nov., 1929.

CONTRIBUTED remarks on two papers indexed in Eng. Index, 1929, from same bulletin Aug. and Oct., 1929.—E.I.S., New York.

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Copper Ore Treatment: Research—The Solvent Action of Ferrous Sulphate Solution on Oxidized Copper Ore. W. G. Murray. *Chem. Eng. and Min. Rev.* (Melbourne), Vol. 22, No. 254, Nov. 5, 1929.

NOTES on experiments carried out on oxidized copper ore from Western Australia.—E.I.S., New York.

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Copper Ore Treatment: Leaching—The New Hedges Copper Leaching Process. P. H. Lietzow. *Mining Journal* (Phoenix, Ariz.), Vol. 13, No. 14, Dec. 15, 1929.

DESCRIPTION of new leaching process for treatment of copper carbonate and oxide ores, producing chemically pure electrolytic copper at mine.—E.I.S., New York.

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Geophysical Exploration, Electric—The Electrical Resistance of Rocks and Ores. M. W. Pullen. *Engineering* (London), Vol. 128, No. 3,333, Nov. 29, 1929.

ABSTRACT of paper previously indexed from U. S. Bureau of Mines—Information Circular, No. 6,141, June, 1929.—E.I.S., New York.

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Crushers: Germany—Improvements in Crushing Machinery (Neuerungen in der Hartzerkleinerung). C. Naske. *V. D. I. Zeit.* (Berlin), Vol. 73, No. 50, Dec. 14, 1929.

DESCRIPTIVE notes on crushing, grinding, pulverizing, and sifting equipment for cement mills and coal-pulverizing plants, manufactured by Humboldt, Kalk. G. Polysius A.-G. Krupp, Fellner and Zeigler A.-G., Fuller-Kinyon and Hildebrandt-Zerkleinerung G. m. b. H. and others, including air blast sifters; sifting record of three-chamber mills.—E.I.S., New York.

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Lead-Zinc Mines and Mining: Canada—Lead and Zinc Situation in Canada. Arthur Buisson. *Canadian Mining Journal.* (Gardenvale), Vol. 50, No. 47, Nov. 22, 1929.

REVIEW of activities in 1928, chiefly in British Columbia, Quebec, and Manitoba; large annual increase in Canadian production of lead and zinc during last six years is mainly due to development of Sullivan mine of Consolidated Mining & Smelting Company of Canada.—E.I.S., New York.

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Beryllium — Beryllium: A History. B. W. Holman. *Mining Journal* (London), Vol. 167, No. 4916, Nov. 9, 1929.

GENERAL notes, considered of interest because of prospective ore supplies from South Africa; success of British metallurgical research; present market conditions; summary description of deposits in two localities in South Africa.—E.I.S., New York.

Geophysical Exploration, Electric—Application of Complex Alternating-Current Compensator in Geo-Electrical Research (Die Anwendung des komplexen Wechselstromkompensators bei geoelektrischen Untersuchungen). W. Geyer. *Archiv fuer Elektrotechnik* (Berlin), Vol. 23, No. 1, Nov. 5, 1929.

MEASURING principles applied in geoelectrical research; graphical presentation of electric current and magnetic fields; measuring of momentary field with complex a.c. current compensator; application of measuring method in geological research. —E.I.S., New York.

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Geophysical Exploration — Geophysical Exploration—Magnetic Process (Los prodedimientos geofisicos de prospeccion el procedimiento magnetico). V. I. Ors. *Ingenieria y Construccion* (Madrid), Vol. 7, Nos. 81 and 83, Sept. and Nov., 1929.

SEPT.: Variation of earth magnetism. Nov.: Permanent magnetic field and Gauss theory; magnetic anomalies, and relation between them and disturbing underground masses; inclined, horizontal, and vertical strata. (Continuation of serial.)—E.I.S., New York.

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Gold Mines and Mining: South Africa—Resuing System of Mining at City Deep, Ltd. A. V. Lange. *Chem. Met. and Min. Soc. of S. Africa—Jl.* (Johannesburg), Vol. 30, No. 3, Sept., 1929. See also *Canadian Mining Journal* (Gardenvale, Que.), Vol. 50, No. 51, Dec. 20, 1929. See also abstract in *S. Africa Mining Review,* Vol. 46, No. 273, Sept., 1929.

RESUING introduced to establish system of mining better suited to conditions in deep-level mining on Central Rand; system is described in detail; sampling and valuation methods; tabular data on stoping results; system is too new to give accurate figure of costs.—E.I.S., New York.

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Tin Deposits—Methods of Boring and Winning Tin in Malaya. B. A. Hadley. *Australasian Inst. of Min. and Met.—Proc.* No. 75, Sept. 30, 1929.

SHORT account of methods boring alluvial tin properties in Malaya; outline of methods of concentrating tin oxide by means of jigs.—E.I.S., New York.

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Phosphate Industry: Tennessee—Phosphate Industry of Tennessee. W. B. Lenhart. *Rock Products,* Vol. 33, No. 5. March 1, 1930.

DESCRIPTIONS of plants and operations of Hoover-Mason Company, and of International Agricultural Corporation, both at Mount Pleasant.—E.I.S., New York.

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Ore Treatment: Flotation — Flotation and Hydrogen Ion Concentration. D. Talmud and N. M. Lubman. *Kolloid-Zeit,* Vol. 50, No. 2, Feb., 1930.

REPORT on experimental studies made at Ore Treatment Laboratory of Moscow Institute of Applied Mineralogy and Metallurgy, on floatability of hydrophile oxides, carbonates and sulphates of light and heavy metals; maximum floatability of oxides and carbonates is in nearly neutral media; no regular relationship between floatability and hydrogen-ion concentration could be discovered for sulphates of metals.—E.I.S., New York.

Tunnels: Construction — The North Lyell Tunnel, Tasmania. G. F. Jakins and E. Barkely. *Chem. Eng. and Min. Rev.,* Vol. 22, No. 255, Dec. 5, 1930.

NOTES on driving of 7,000-ft. adit tunnel, to connect ore treatment plant with North Lyell mine at depth of 1,100 ft., to effect economies in transportation and drainage; cross section 9 ft. square; driven from both ends and completed in less than 15 months. Abstract of paper read before Australasian Inst. Min. and Met.—E.I.S., New York.

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Ore Treatment—Die Aufbereitung von Kohle und Erzen. A. E. Liwehr. Vol. II, Leipzig, Arthur Felix, 24 marks. Reviewed in *Engineering,* Vol. 129, No. 3344, Feb. 14, 1930.

BOOK is second part of work to be completed in three volumes; present volume is devoted to various methods of wet separation; critical account of typical methods, including recent improvements. — E.I.S., New York.

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Separators, Magnetic—Alternating Current in Magnetic Separation. J. A. L. Ortlepp. *Chem., Met. and Min. Soc. of S. Africa—Jl.,* Vol. 30, No. 4, Oct., 1929.

DESCRIPTION and discussion of investigation as to removal of magnetic iron oxides from concentrates produced by Leeuwpoort Tin Mines, Ltd.; theoretical considerations and experimental evidence in support thereof; practical applications of principles; success in concentration is attributed to efficiency of high frequency magnetic separator.—E.I.S., New York.

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Mine Ventilation—A Note on Tip and Ore-Bin Ventilation, J. Thorlund. *Chem., Met. and Min. Soc. of S. Africa—Jl,* Vol. 30, No. 4, Oct., 1929.

DISCUSSION by R. A. H. Flugge-de Smidt, of paper indexed in Engineering Index, 1929, from May, 1929, issue of same journal.—E.I.S., New York.

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Zinc Ore Treatment, Electrolytic — Technical and Commercial Viewpoint of Modern Methods of Zinc Electrolysis. G. Eger. *Zeit, des Oberschlesischen Berg- u. Huettenmaennischen Vereins zu Katowice,* Vol. 68, No. 12, Dec., 1929.

OLD METHODS with low current density and low acid contents and Tainton method with high current density and high acid contents are discussed; main parts of modern plants are described; comparison of methods; recommendations for new plants.—E.I.S., New York.

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Platinum Ore Treatment — The Recovery of Platinum from Dunite Rock at Onverwacht, Transvaal. T. K. Prentice and R. Murdoch. *Chem., Met. and Min. Soc. of S. Africa—Jl.,* Vol. 30, No. 4, Oct., 1929.

AUTHOR'S reply to discussion of paper indexed in Engineering Index, 1929, from various sources.—E.I.S., New York.

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Rubber Manufacture: Lead Recovery—Recovering Lead in Rubber Factory. F. L. Haushalter. *Chem. and Met. Eng.,* Vol. 37, No. 2, Feb., 1930.

PROBLEM of controlling physical properties of lead recovered from casing after vulcanization of hose; comparison of tensile strength of pure lead with lead tubes before and after pure and with refined dross. —E.I.S., New York.

PATENTS

Concentrator. No. 1,745,070. Jan. 28, 1930. E. W. Warfield, Rutherford, N. J.
Design for a wet ore concentrator.

Miner's Safety Lamp. No. 1,746,113. Feb. 4, 1930. J. Giacomini, Rains, Utah.
Attaching device for miner's safety lamp.

Flotation Apparatus. No. 1,746,682. Feb. 11, 1930. J. P. Ruth, Jr., Denver, Colo.
Design for a pneumatic flotation cell.

Ball Mill. No. 1,745,480. Feb. 4, 1930. R. Garlick and H. Sellman, assignors to Paul O. Abbe, Inc., Little Falls, N. J.
Design for discharge valve for ball mill.

Rock Drill. No. 1,744,964. Jan. 28, 1930. C. C. Hansen, assignor to Ingersoll-Rand Company, Jersey City, N. J.
Design for a retracting device for a rock drill.

Slime Filter. No. 1,744,480. Jan. 21, 1930. C. Lintecum, Tonopah, Nev.
Method for filtering cyanide slimes, and apparatus for this purpose.

Miner's Lamp. No. 1,744,416. Jan. 21, 1930. G. Schauly, Nantes, France.
Miner's safety lamp indicating the amount of fire damp in the air.

Hammer Rock Drill. No. 1,744,141. Jan. 21, 1930. L. Pryce, Johannesburg, Transvaal.
Design for a hammer rock drill.

Mining Drill. No. 17,557. Reissue. Jan. 7, 1930. F. W. Thurston, Los Angeles, Calif.
Design for an impact mining drill.

Hoisting Mechanism. No. 1,740,706. Dec. 24, 1929. Charles F. Osgood, assignor to Sullivan Machinery Company.
Design for a hoist.

Rock Drill. No. 1,740,122. Dec. 17, 1929. Fred M. Slater, assignor to Ingersoll-Rand Company, Jersey City, N. J.
Design for a fluid-actuated rock drill.

Hoisting Mechanism. No. 1,742,180. Dec. 31, 1929. C. F. Osgood, assignor to Sullivan Machinery Company, of Massachusetts.
Design for a mine hoist.

Concrete Tanks. No. 1,740,011. Dec. 17, 1929. George C. Evans, Perth Amboy, N. J.
A reinforced-concrete tank with bottom, sides, and ends made separately.

Drilling Mechanism. No. 1,740,701 & 1,740,703. Dec. 24, 1929. Charles F. Osgood, assignor to Sullivan Machinery Company.
Design for fluid-activated rock drills.

Hoisting Mechanism. No. 1,740,702,-4, 5, & 7. Dec. 24, 1929. Robert C. Osgood, assignor to Sullivan Machinery Company.
Design for hoists.

Silver Extraction. No. 1,747,072. Feb. 11, 1930. E. Haehre, assignor to Thomas Roberts and Raymond Theobald Hartmann, London, England.
A process for treating the ores of silver containing native silver, in which the ore is subjected to treatment to form silver sulphide, followed by flotation.

Mine Locomotive. No. 1,742,013. Dec. 31, 1929. W. W. Sloane, assignor to Goodman Manufacturing Company, Chicago, Ill.
Safety device for mine locomotives.

Sintering Machine. No. 1,741,943-4. Dec. 31, 1929. J. R. Linney, Clinton County, N. Y.
Sintering machine having a continuously moving train of grate bars.

Tube-Mill Shell Liner. No. 1,741,604. Dec. 31, 1929. F. R. Barratt, Krugersdorp, Transvaal.
Grinding with a charge of large and small bodies acting as a grinding medium.

Hoisting Mechanism. No. 1,742,088. Dec. 31, 1929. L. A. Maxson, assignor to Sullivan Machinery Company, of Massachusetts.
Design for a mine hoist.

Drilling Mechanism. No. 1,742,166. Dec. 31, 1929. E. G. Gartin, assignor to Sullivan Machinery Company, of Massachusetts.
Design for a rock drill.

Hoisting Mechanism. No. 1,742,142. Dec. 31, 1929. W. S. Hofstra, assignor to Sullivan Machinery Company, of Massachusetts.
Design for a mine hoist.

Sulphuric Acid. No. 1,741,310. Dec. 31, 1929. A. O. Jaeger, assignor to Selden Company, Pittsburgh, Pa.
Contact process for production of sulphuric acid.

Electrolytic Cell. No. 1,745,688. Feb. 4, 1930. F. F. Poland, assignor to American Smelting & Refining, New York, N. Y.
Arrangement of electrode contact.

Electrolytic Cell. No. 1,745,348. Feb. 4, 1930. F. F. Poland, assignor to American Smelting & Refining, New York, N. Y.
Design for electrode contact in an electrolytic cell, and method for cleaning it.

Sulphur Dioxide Recovery. No. 1,740,-342. Dec. 17, 1929. Christian Hansen, assignor to I.G. Farbenindustrie, Frankfurt a/M, Germany.
Recovery of sulphur dioxide by absorption in ammonium sulphite.

Agglomerating Ores. No. 1,739,839. Dec. 17, 1929. Peter Jung, Berlin-Neukolln, Germany.
A process for agglomeration of ores and similar products using a colloidal dispersion as a binder.

Metallurgical Furnace. No. 1,746,904. Feb. 11, 1930. R. D. Pike, Piedmont, Calif.
A metallurgical furnace with a central, artificially cooled body, buried in the charge, from which a burner projects, and through which oxygen may be supplied to the smelting zone.

Electric Furnace. No. 1,741,469. Dec. 31, 1929. B. Long, assignor to Société Anonyme des Manufacture des Glaces & Produits Chimiques de St. Gobain, Paris, France.
Electric furnace having an electrode of molten metal projecting into the furnace and extending outside.

Flotation Process. No. 1,741,030. Dec. 24, 1929. Henry T. Koenig and Sherwin P. Lowe, assignors to R. H. Channing, Jr., San Francisco, Calif.
Addition of a froth-accelerating alkaloid consisting of cinchonine sulphate to the pulp.

Mining Machine. No. 1,746,706. Feb. 11, 1930. I. C. Lightfoot, Merriam, Kansas.
A double air separator for grading materials. The tailing from the first unit is classified in a second unit. Both separators have independent air circuits.

Air Separator. No. 1,746,686. Feb. 11, 1930. T. J. Sturtevant, assignor to Sturtevant Mill Company, Boston, Mass.
A dry placer mining machine consisting of a rotating cylinder where the crushed ore is exposed to an air blast before amalgamating.

Amalgamator. No. 1,744,427. Jan. 21, 1930. J. F. Welsh, Pueblo, Colo.
Rotatable amalgamator having an interiorly riffled bowl, which may be used for treatment of fine as well as coarse material.

Precipitation of Tin. No. 1,742,284. Jan. 7, 1930. H. M. Schleicher, assignor to American Metal Company, Ltd., New York, N. Y.
Precipitation of tin compounds from solution by adding the reagent in two stages.

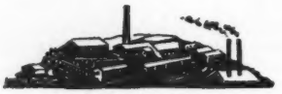
Asbestos Ore Refining. No. 1,741,869. Dec. 31, 1929. F. A. Meet, assignor to Powhatan Mining Corporation, of Maryland.
Comminuted asbestos ore is subjected to combined drawing and rubbing action in a non-solvent liquid.

Electrode. No. 1,740,291. Dec. 17, 1929. Colin G. Fink and Russell E. Lowe, assignors to Bario Metal Corporation, New York, N. Y.
An electrode having a metallic body portion composed of an alloy containing lead and silver with higher content of silver than lead.

Briquetting Flue Dust. No. 1,741,544. Dec. 31, 1929. E. A. Slagle and B. M. O'Harra, assignors to American Smelting & Refining Company, New York, N. Y.
Fume containing colloidal matter is mixed with an acid defloculating agent and sufficient water to make the mixture plastic. The mixture is briquetted and dried.

Recovering Metals. No. 1,746,945. Feb. 11, 1930. R. W. Hyde, assignor to Dwight & Lloyd Metallurgical Company, New York, N. Y.
A process for recovering metals of low melting point from their sulphide ores, consisting of sintering in oxidizing atmosphere, followed by reduction at a temperature above the melting point of the metals, but below the melting point of the residue.

INDUSTRIAL PROGRESS



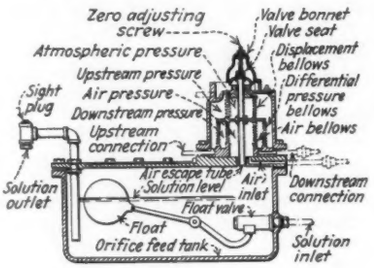
Proportioning Flow in Softening Feed Water —Other New Developments

ACCURATE proportioning of one fluid to another is required in various processes, as in water softening. Devices are in use in which the primary stream and the secondary stream are each measured by means of the pressure differential due to the flow of the respective stream through an orifice, the two differentials acting upon a balance by which the flow of the secondary fluid is controlled automatically. Sometimes, however, the fluid to be controlled may be corrosive, as, for example, sulphuric acid solution, or may be otherwise of such a nature that it should not come into direct contact with the diaphragms or pistons of the balancing mechanism.

The air-balanced proportioner shown herewith has been developed to overcome this difficulty. The sectional view shows that the corrosive solution is held at a constant level in a feed tank by means of a float-regulated valve which controls inflow from a source of higher pressure; the outflow of the corrosive solution is through an orifice. Pressure acting upon the outflow orifice is determined by the air pressure above the liquid level in the solution tank, this pressure being regulated automatically as follows:

Mounted upon the solution tank is a balancing device consisting of three corrugated bellows, all attached to a single movable diaphragm which carries on an axially placed tube a valve member co-acting with a stationary valve member at the top.

The surface of the diaphragm contained within the inner pair of bellows is acted upon beneath by the air pressure within the feed tank; the upper surface is open to the atmosphere. The annular portion of the diaphragm outside of the inner bellows and within the outer bellows is acted upon on its upper surface by the pressure from the upstream side of an orifice in the primary flow pipe and upon its underside by the presure from the downstream side of the same orifice. Differential due to the flow of the primary liquid is thus balanced against the pressure within the orifice feed tank. Should the latter be greater in proportion than the differential due to the primary flow, the valve member will rise and allow some of the air in the orifice solution tank to escape. On the other hand, should the differential pressure be the greater, the orifice member will fall so that no air can escape; but inasmuch as air is constantly flowing into the solution chamber from a supply source, the air pressure will build up until the valve will again be lifted. In other words, in operation the valve is always leaking, more or less, and the pressure within



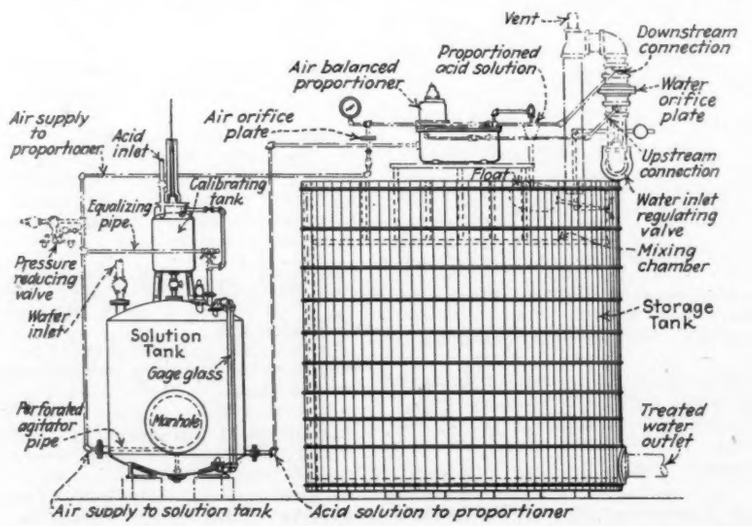
Details of the air-balanced proportioner

the orifice feed tank is always proportional to the differential, due to flow of the primary liquid. The rate of inflow of air into the orifice feed tank is through a small orifice in the supply pipe. If the pressure of the source from which this air is taken is roughly more than twice the highest pressure carried in the orifice feed tank, the rate of inflow will be constant.

The sectional drawing indicates that the entering air first flows into the space within the lower inner bellows and downward through the clearance around the tube attached to the diaphragm and serving both to guide the diaphragm and to carry the valve member. The outflow of air to the valve takes place up through this tube. There is thus no opportunity for acid vapors to penetrate into the bellows chamber and attack the bellows; and, also, most of the air flowing out through the valve will be fresh incoming air and not acid-laden.

When the apparatus is put into operation, a spring bearing upon the top of the movable tube is so adjusted that pressure will be held in the orifice feed tank just sufficient to raise the acid solution to the level of the outflow orifice when there is no differential pressure from the primary flow pipe. The flow through the primary flow pipe causes a differential loading to be applied to the bellows which increases as the square of the rate of flow. An equivalent opposing air pressure will at the same time be built up in the feed tank, and the flow of acid out through the orifice will vary as the square root of this air pressure, and will, therefore, be directly proportional to the flow of the primary fluid. The outflow through the orifice takes place into an open funnel, so that it can readily be inspected.

The tank from which the acid solution is received may be located below the air-balanced proportioner and the acid lifted up to the latter by admitting pressure from the primary air supply to the solution tank. Similarly, the latter may be fitted with a calibrated measuring tank and with air pressure connections so that acids can be charged into the solution tank without releas-



Use of air-balanced proportioner in connection with equipment required for softening feed water

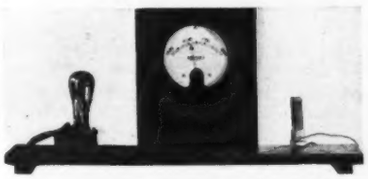
ing the pressure on the latter. The supply for the proportioner may be also obtained from an elevated tank or by means of a constantly running centrifugal pump if desired.

To secure good mixing in the solution tank, various agitating means may be used, the one shown in the assembly drawing consisting of a perforated air pipe. In other cases mechanical agitators may be employed.

The apparatus described has been developed by the Cochrane Corporation, Philadelphia, for feeding sulphuric acid solution into boiler feed water in order to correct abnormally high causticity, particularly in water softened by means of zeolite filters, and thus to prevent caustic embrittlement in boilers.

"Electric Eye" Tells Temperature of Hot Metal

Recently at the Westinghouse Lighting Institute in New York City, J. V. Breisky, one of the research engineers of the Westinghouse company, showed how with the aid of the photo-electric cell the temperature of steel and other hot metal in various processes of manufacture can be determined accurately and automatically without the aid of human eyesight and judgment. Previously, no mechanical device has been found quick enough to give the essential instantaneous record of temperature. In experimenting with such earlier devices big losses of metal have therefore occurred when errors were made in estimating the temperature.



The "electric eye" tells temperature

Mr. Breisky demonstrated the precision of the new device in measuring temperature. On the table before him was a photo-electric cell unit (the so-called "electric eye"), a glow heater, and a meter calibrated in degrees of temperature. A varying current was made to pass through the heater, the temperature in the heating element thus being made to rise and fall. The slightest change—hardly noticeable to the human eye—caused an instantaneous variation in the reading of the meter. In all the processes of making steel the photo-electric cell has been found to indicate with accuracy temperatures from 1,300 deg. F. up to the highest degree of heat encountered.

Much steel is said to be scrapped annually in the United States alone or else sold as an inferior product, because of lack of accurate temperature control. For this reason, considerable profit is expected to be had through using the "electric eye." One reason why it is essential to avoid such waste is the great increase in use of alloy steels, which are much more expensive than ordinary steels.

Control of the lighting of a mill yard or plant is also possible with the aid of the photo-electric cell, as was shown under demonstration. This consists simply in the use of the cell to turn on the artificial light whenever the daylight, as it wanes, falls below a certain intensity. This means may be used to operate either the interior lighting of a plant, or floodlighting or other kinds of illumination outside. By this means illumination may be maintained at constant intensity at a given point. This automatic control is now used in one of the largest factory aisles in the Westinghouse plant at East Pittsburgh. Several other large industrial concerns are reported to be installing similar units.

A demonstration was also made of other devices developed with the aid of the photo-electric cell. Everyone entering the room was automatically counted as he crossed a beam of light which was thrown across the doorway. The shadow of a passing body caused the "electric eye" to communicate with a counting machine. An automatic sorting machine was able to detect differences in the appearance of packages. A related device operated a fire extinguisher as soon as the first whiff of smoke appeared. The ingenuity of modern research engineers is thus bringing a quick solution to many difficult problems.

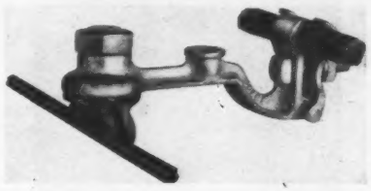
Some New Hammer Mills

A new line of swing- and ring-type hammer mill crushers and pulverizers has recently been introduced by Stedman's Foundry & Machine Works, Aurora, Ind. It comprises three types and 25 sizes ranging from 5 to 250 hp. Of the three types, two have features suitable for the reduction of stone, lime, and gypsum, according to the company. One of these, a general-purpose machine, built in seven sizes, reduces material in two stages and can be used for grinding material such as limestone down to 10 to 40 mesh or even finer. It is said to have large capacities and low maintenance cost and to give a uniform product. It has a built-in metal trap, heavy renewable wearing plates, adjustable grinding plates, and self-aligning ball bearings. All parts are accessible.

Another of the three types (Type B) is made in twelve sizes for heavy-duty work, such as crushing limestone and gypsum. The larger size will reduce 24-in. cubes to ¾-in. in one reduction. Being intended for more severe service, this type is of heavier construction than the one previously described.

Trolley Hanger Improved

To lessen the amount of material and installation labor required and to feed current more efficiently to the trolley wire, the Ohio Brass Company has developed a new dual feeder and trolley suspension, shown in one of the cuts. Using a single suspension point, it needs only one roof attachment and one insulated hanger to carry both trolley wire and feeder. The wire is hung from a clamp similar to the company's Bull Dog type, and any size feeder wire from 6/0 to one million circular mils



An improved trolley hanger

is accommodated. Because of its continuous metal construction, a feeder connection is provided at each suspension point, this reducing the heating of the trolley wire from overload, and providing the maximum for locomotive operation. The design is such as to eliminate the possibility of trapping the trolley pole in case dewirement takes place.

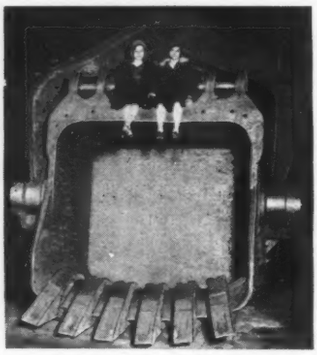
Reduction Unit for Agitator Drives

At a smelter at Perth Amboy, N. J., a unique gear unit assembly is being used to obtain the speed reduction required on heavy-duty agitator drives. Power from a 20-hp., 1,150-r.p.m. motor is transmitted first through a Westinghouse - Nuttall Type SVR single-reduction unit having a ratio of 7.9:1 and then through a right-angle bevel-gear unit, of similar make, having a ratio of 2 to 1. The slow-speed shaft of the bevel gear extends through the bottom of the case, as the complete drive is located on top of the agitator. The motor and the SVR unit are mounted on a cast-iron bedplate, which in turn is mounted with the other unit on a flat-rolled steel plate, making a complete assembly. Flexible couplings connect motor and units.

"Trip-Free" Circuit Breakers

A new line of "trip-free" air circuit breakers has been placed on the market by General Electric. Their principal advantages are said to be as follows: They are trip-free from the handle on overcurrent; triple contact is provided; there is no burning on the main brush; burning tips are easily replaced; the high-pressure main contact is formed of laminations which make "end-on" contact with heavy and uniform pressure, and yet is closed easily with a wiping motion. They have low operating tem perature. The breakers are available for either instantaneous or time-delay automatic operation in either single-, double-, or triple-pole combinations with necessary accessories. They may be had in three classifications—namely, for

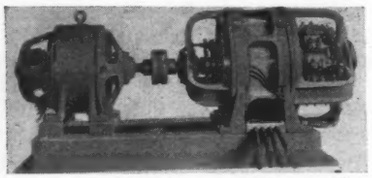
voltages of 650 and below. Type CN-1 is intended for service where the current is from 3 to 300 amp.; Type CP-108 for circuits of 1,200 amp. and below. Type CK-8 is intended for heavy duty where the current ranges from 1,600 amp. up.



A 15-cu.yd. dipper of manganese steel

Largest Dipper of Manganese Steel

One of the illustrations on this page shows an all-manganese-steel dipper made by the American Manganese Steel Company for the huge 15-yd. electric stripping shovel (Marion) of the United Electric Coal Company, Danville, Ill. This shovel was described in the 1929 Annual Review Number of *Engineering and Mining Journal* (Jan. 19, 1929, p. 131). The dipper is 14 ft. high over the bail, 12 ft. wide between the outsides of the bail brackets, and 14 ft. from the ends of the dipper teeth to the bottom of the door. It weighs 37 tons when empty and has 15 cu.yd. capacity.



A new frequency converter

For Changing Frequency

Where the current furnished by the power company is of a frequency different from that desired, the special frequency converters developed by the Reliance Electric & Engineering Company, Cleveland, Ohio, may be found serviceable. These are built for operation in either two- or three-phase current, and provide an economical method, the manufacturer says, of obtaining single-phase, two-phase, or three-phase current at any low frequency. Especially economical are they for obtaining low frequencies such as 3 to 15 cycles. They have been used to obtain variations in speeds with squirrel-cage induction motors and to get speeds which are either higher or lower than those obtainable from induction motors that operate on a standard frequency.

For Stand-by Generators

A new development in automatic switching equipment for use when a.c. generators are direct-connected to gasoline engines for stand-by service has been developed by General Electric. It is mounted on standard size panels, so that it may form part of a switchboard which also takes care of power distribution. It may be had in either single or double unit. An automotive starting unit is provided for the engine and is energized from a storage battery which is kept charged by means of a tungar rectifier connected to the a.c. source. Therefore, when the indication is given of the failure of the normal a.c. power supply, the engine starts automatically and the generator is connected to supply emergency power. Upon return of power to the preferred source, the ignition system of the engine is interrupted to shut down the unit and the preferred line breaker is reclosed, restoring normal operation. Standard protective features are also included.

BULLETINS

Switch — Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Leaflet No. 20440, which describes automatic sectionalizing equipment for railway service at 600 volts d.c.

Switchboards — Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. A.I.A. File No. 31d21, describing truck-type switchboards.

Welding—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-874E, describing Type WD-200A arc welder.

Welding—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-875E, describing Type WD-300A arc welder.

Boilers — Combustion Engineering Corporation, 200 Madison Ave., N. Y. City. Bulletin BVM1, describing VM-type boilers (Bent Tube.)

Crushers — Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Leaflet No. 2116, which describes crushing plant efficiency to be increased with Style "B" Newhouse crushers.

Instruments—The Bristol Company, Waterbury, Conn. Catalog No. 1009, recording pressure and vacuum gages.

Flotation—The Ruth Company, Denver, Colo. Book entitled "Flotation Mills," describing mills using the company's equipment.

Screens—The W. S. Tyler Company, Cleveland, Ohio. Catalog No. 54, entitled "Screening for Profit." Describes the Hum-mer electric screen.

Painting—New Jersey Zinc Company, New York, N. Y. "Painting Galvanized Iron and Other Zinc Surfaces," by H. A. Nelson, comprising (1) factors governing adherence of paint to new galvanized iron and sheet zinc surfaces; (2) weathering before painting; (3) pretreatments; (4) use of specially prepared sheets; (5) suitable paints. The bulletin also contains the results of tests and a statement of conclusions.

Locomotives—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-70A, describing mine locomotives trolley-type and gathering.

Controllers—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-948A, which describes CR4065 d.c. magnetic controllers.

INDUSTRIAL NOTES

Wellman-Seaver-Morgan Company, of Cleveland, Ohio, has changed its name to Wellman Engineering Company.

Connersville Blower Company announces that John T. Wilkin, president and chief engineer, has been appointed general manager.

Cutler-Hammer, Inc., announces the removal of its Detroit branch office to 2755 East Grand Boulevard, Detroit, Mich.

Nordberg Manufacturing Company, of Milwaukee, Wis., has appointed Charles H. Gaut to its sales and service staff, with headquarters in Knoxville, Tenn.

Chicago Pneumatic Tool Company, of New York, announces the opening of a branch office in Tulsa, Okla., with George J. Lynch as district manager in charge.

Naylor Pipe Company, of Chicago, has appointed J. V. McMullan as foreign sales manager, with headquarters in New York.

Moeller Instrument Company, of Brooklyn, N. Y., is the successor to the A. E. Moeller Company.

Link-Belt Company has opened a branch office in Vancouver, B. C., with Frank B. Wetherill in charge.

Harnischfeger Corporation announces that R. H. McGredy has joined the staff of the Harnischfeger Sales Corporation, with headquarters in New York.

Sullivan Machinery Company, of Chicago, announces that John S. Walker, Jr., manager of the Huntington branch office, has resigned and will be succeeded by Morley S. Sloman, who has been at the Pittsburgh branch office.

American Air Filter Company, on and after April 1, is the operating name of the consolidation of the Reed, Midwest, and National Air Filter companies.

American Refractories Institute will hold its annual meeting at White Sulphur Springs, W. Va., on May 19 and 20.

Nordberg Manufacturing Company, of Milwaukee, Wis., has appointed Harry W. Newton to its technical staff, with headquarters in Milwaukee.

Atlas Car & Manufacturing Company, of Cleveland, Ohio, announces the appointment of J. Q. Lalor, of Denver, as its agent for Colorado and Northern New Mexico.

Cutler-Hammer, Inc., of Milwaukee, Wis., has appointed M. C. Steffen manager of the Cincinnati branch office, to succeed R. I. Maujer, who has resigned.

The Ohio Electric Manufacturing Company is the new name adopted by the former Ohio Electric & Controller Company, of Cleveland, Ohio.

Easton Car & Construction Company, of Easton, Pa., announces completed arrangements with **E. Constantin,** of Paris, France, to manufacture the Easton line in France.

Personal Notes

W. J. O'Connor, manager of the Utah division of American Smelting & Refining, is in Los Angeles.

G. Chester Master sailed from New York late in March for Northern Rhodesia on examination work.

E. A. Cappelen Smith, president of Anglo-Chilean Nitrate, sailed from New York for London on April 4.

Samuel Fisher sailed from New York for Chile on March 13, to join the technical staff of Chile Exploration.

Bernard Beringer sailed from New York for Peru on March 28, to join the technical staff of Cerro de Pasco.

A. Cadogan recently arrived in San Francisco from northern Mexico, and plans to return there in the near future.

Reno H. Sales, chief geologist for Anaconda Copper Mining, has returned from Chile.

F. E. Calkins recently completed an examination and report on the United Verde Extension mine for the Arizona State Tax Commission.

R. J. Orynski, recently consulting metallurgist for Mexican Candelaria, at San Dimas, Durango, Mexico, has returned to San Francisco.

Dr. **L. C. Graton** delivered an address before the Washington section of the A.I.M.E. on March 27. His subject was, "Deep Mines of the World."

H. H. Utley, of Florence, Colo., will succeed **L. T. Ledyard** as manager of the St. Louis Smelting & Refining properties in the Tri-State district.

George S. Dyer, manager of dredging operations of Lena Goldfields, at Bodaibo, Siberia, has returned to San Francisco on a leave of absence.

O. E. Keough, formerly concentration engineer for International Smelting, is en route for Siberia, where he goes to take a position with Selection Trust.

Charles W. Henderson, in charge of the Denver office of the U. S. Bureau of Mines, has been elected chairman of the Colorado section of the A.I.M.E.

V. E. Flanagan, formerly mill superintendent for Georgia Manganese & Iron, has resigned to accept a position with New Jersey Zinc, at Franklin, N. J.

W. Mont Ferry, president of the American Silver Producers' Association, is in New York City, attending a meeting of the executive committee of the association.

Arthur Zentner has returned to San Francisco after an extended professional trip through Texas, the eastern United States and Canada, and the Pacific northwest.

H. DeWitt Smith, director of Newmont Mining, returned to New York City on March 24, from a trip of inspection of his company's properties in Peru and Bolivia.

Frederic R. Weekes and **E. Perry Crawford** have opened an office as consulting engineers in Vancouver, B. C. **Lester G. Morrell** is associated with them at the same address.

G. H. Sharrer, operating manager for the McNamara Company, is making plans for the resumption of operations on the company's Coffee Creek property in Trinity County, Calif.

F. W. Bradley, past president of the A.I.M.E., received the honorary degree of Doctor of Laws on March 24, at the Charter Day ceremonies of the University of California.

FRANCIS H. BROWNELL

Francis H. Brownell was elected chairman of the board of directors of American Smelting & Refining, at a meeting of the board on April 2. He succeeds **Edgar L. Newhouse,** who recently resigned after more than 40 years' association with the company. Although no longer active as an operating official, Mr. Newhouse will continue as a director. The other officers and members of the board were re-elected.

H. B. Prather sailed from New York for Russia on March 20. He will be connected with the Giprotzvetmet, the state institute for the control and projecting of metallurgical plants.

George C. R. Stewart, formerly in charge of operations of Rio Tinto, has been appointed general manager of Rhodesian Congo Border Concession, Ltd., and N'Changa Copper Mines, Ltd.

F. F. Frick, research engineer for Anaconda Copper Mining, is in New York on his return from South America to his headquarters at Anaconda, Mont., after a two years' stay at Potrerillos, Chile.

C. L. Poston, manager of the Joplin office of American Metal, has been transferred to the Ontario Refining plant, at Copper Cliff, Ontario. **Clyde Ingram,** ore buyer, will be in charge of the Joplin office.

Julian B. Beaty has been elected a director of Nichols Copper, to fill the vacancy created by the death of **Dr. William H. Nichols. Henry J. Hartley** has been elected an additional vice-president.

George E. Cole, Chief Inspector of Mines for Manitoba, will become Provincial Director of Mines and head of the new department which is being organized to control the mineral resources of the province.

Richard N. Hunt, consulting geologist, formerly with U. S. Smelting, Refining & Mining, recently completed a mine examination in Mexico, and is now at Anyox,, B. C., on special work for Granby Consolidated.

Milo W. Krejci, Julius H. Gillis, and **I. Schilowsky,** all of the staff of **Archer Wheeler,** are sailing from New York for Moscow on the "Bremen" on April 12. Other members of the staff will follow in the near future.

Ludwig Vogelstein, formerly president of U. S. Metals Refining, has been elected to the newly created position of chairman of the board of directors. **Heath Steele,** formerly vice-president and general manager, has been made president.

E. W. Pinney, of the engineering staff of the Garfield smelter of American Smelting & Refining, will soon leave for the Shorey plant of Northern Peru Mining & Smelting, in Peru. Following special work there he will return to Salt Lake City.

F. W. Draper, of Mount Isa Mines, Ltd., of Queensland, Australia, delivered an address on March 18 before the Mining and Metallurgy Association of the Missouri School of Mines. Mr. Draper was formerly professor of metallurgy at this school.

Guy E. Ingersoll, assistant professor of mining and metallurgy at the Washington State College, Pullman, Wash., left on April 7, with a party of about twenty students, to visit the mines, mills, and smelters of the Coeur d'Alene district.

Henry A. Tobelmann, for the last four years in charge of operations for Ohio Copper, in Utah, has been retained to do consulting work for N'Changa Copper Mines, Ltd. He will make a preliminary investigation of the treatment of refractory copper ores. He left Salt Lake City recently for South Africa via London.

OBITUARY

Mrs. E. H. Hamilton, of Montreal, Que., died there on March 19, at the Royal Victoria hospital.

Samuel H. Kellock, manager of Ohio Copper from 1916 to 1926, died at Salt Lake City on March 16.

James Brown, of Leadville, Colo., former operator of the Ibex and Little Johnnie mines, died in Pueblo, Colo., on March 25.

Albert W. Crawford, mine owner and banker, died at his home in Los Angeles, on March 27. He was active in the early development of Leadville, Colo., and at the time of his death was owner of the Times and Hercules groups of mines at Oatman, Ariz. He was 75 years of age.

Daniel F. Higgins, Jr., professor of geology at Lincoln Memorial University, Harrogate, Tenn., died on March 21, at Knoxville, Tenn. He had a wide practical experience in mining geology, and was at one time connected with the topographic branch of the U. S. Bureau of Mines. Mr. Higgins was 46 years of age, and is survived by his widow and two daughters.

NEWS OF THE INDUSTRY

Howey Gold Starts Its Mill, Pioneer in Patricia Area

Sudbury, Ont., April 4, 1930—The new 500-ton cyanide mill of Howey Gold Mines, at Red Lake, in the Patricia district, started operating on April 2, according to a wire received yesterday from Horace Young, manager of the company. The first clean-up is expected to be made late this month or early in May. All parts of the plant, which was built by General Engineering, of Salt Lake City, Utah, are working satisfactorily.

Howey Gold is the first property in the Patricia district to come into regular production. Some gold has been produced from small, high-grade deposits, such as the Bobjo. Howey was the original discovery that attracted attention to the Red Lake and Woman Lake camps about four years ago. Since then a shaft has been sunk to 1,000 ft. and ore has been proved to that depth. Average grade is about $7 a ton over an average width of about 15 ft. to the 500 level. At greater depths the ore is said to be wider and of better grade.

Handling 500 tons of $7 ore daily, Howey is expected to produce about $1,250,000 in gold annually. J. E. Hammell, president of the company, has estimated costs at $4 a ton. The mill is expected to handle more than the rated capacity of 500 tons, some estimates placing the possible tonnage at 750. In addition, provision has been made for further increasing the capacity if desirable. Power for operations will be obtained from the Ear Falls development of the Ontario government, 40 miles distant. A total of 2,000 hp. will be used, and the rate will be only $25 per horsepower-year, the lowest in any Ontario mining district. Howey advanced $200,000 for construction of the transmission line.

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Northwest Association Names Men on Silver Committee

The Northwest Mining Association has named a silver committee to assist in a program for enlarging consumption of the metal. The committee consists of J. O. Elton, manager, International Smelting, Tooele, Utah; J. F. McCarthy, president, Hecla Mining, Burke, Idaho; Frank M. Smith, Bunker Hill & Sullivan, Spokane, Wash.; John Sawbridge, president, Sunshine Mining, Wallace, Idaho; C. W. Butters, president, Exploration Company of California, South Mountain, Idaho; Dr. Francis Thomson, president, Montana State School of Mines, Butte, Mont.; and F. Cushing Moore, A. W. Foster, Leon Starmont, Rowland King, and L. K. Armstrong, officers of the association. A meeting will be held as soon as Mr. Elton can go to Spokane from Salt Lake City.

Production From Clay Orebody Will Start at Morenci by 1934, Phelps Dodge Plans

PRODUCTION from the low-grade Clay orebody, on which Phelps Dodge has been doing development and experimental work, will start at Morenci, Ariz., about 1934, according to Walter Douglas, president of the company, in the annual report recently issued. Intensive exploration has blocked out 245,000,000 tons of ore, averaging about 1.12 per cent copper, with the probability that this reserve can be greatly increased when necessary and desirable. Production will be on the scale of 25,000 tons daily, when started, and is expected to result in an output of about 165,000,000 lb. of copper annually, as contrasted with the present annual output of about 55,000,000 lb. of copper from the Morenci branch.

Mining of the greater part of the Clay orebody will be conducted through tunnels. Results from both concentration and leaching tests indicate a satisfactory copper extraction, and pilot plants are now being built further to confirm these tests. Operation of the pilot plants will be continued for one year before construction work on the final plant is started. Plans and estimates are being prepared for this plant, and work on putting the mine in condition for production will be started soon. The Clay mine will start production at about the time that the higher-grade concentrating ores in the Humboldt mine, from which the branch now obtains its output, are exhausted.

The cut-off point between ore and junore at Morenci will be 0.7 per cent copper when the Clay orebody is brought into production. This compares favorably with the minimum grade at Utah and Miami. Conservative estimates of cost, Mr. Douglas states in the report, indicate that Morenci will be in the low-cost class. Per-pound costs for Phelps Dodge in 1928, after crediting precious metals, were 10.4c. from all mines.

No estimate of the cost of equipping the Clay orebody for production was given in the report, but Mr. Douglas points out that the company has accumulated a large cash reserve, now amounting to $17,600,000, which can be used for this purpose. If concentration methods are used, presumably the existing smelter at Clifton will be enlarged to handle the larger output.

Total output from Phelps Dodge properties in 1929 was 218,360,613 lb. of copper. Ore reserves both at Copper Queen, in the Bisbee district, and at Moctezuma, the company's Mexican subsidiary, were increased, despite the large output from these mines. No ore has yet been found in the Warren shaft exploration program at Bisbee, although mineralization has been struck. In the limestone mines the most favorable development results were obtained in the Czar and Holbrook areas; and in the porphyry ground, near the Sacramento shaft, additional churn drilling is now under way. Total development done at Bisbee in 1929 was 40,784 ft. of workings and 7,673 ft. of diamond drilling, exclusive of 10,887 ft. of exploration work in the Warren shaft area.

A contract has been awarded to the E. J. Longyear Development Company to sink the Warren shaft from its present depth of 2,200 ft. to 3,200 ft. Sinking will be started about May 1. The Longyear company had the contract for sinking this shaft when it was put down to its present depth in 1927.

Diamond drilling at Moctezuma, in northern Sonora, continued to give excellent results, according to P. G. Beckett, general manager. Development work on the Nos. 19, 20 and 21 levels did not advance as rapidly as anticipated, but considerable new ore was found in the upper levels of the mine. A good-sized orebody has been struck in the south end of the Nos. 19 and 20 levels.

■

Hollinger Marks Time Pending Completion of Graton Survey

Development work at depth on the property of Hollinger Consolidated, near Timmins, Ont., has been largely suspended, pending the completion of the geological survey being made by Dr. L. C. Graton and assistants, according to A. F. Brigham, general manager of the company. In 1929, only 29,174 ft. of crosscuts was driven, compared with 51,120 ft. in 1928. Nevertheless, ore reserves showed a shrinkage of only 200,000 tons, despite extraction of 1,549,157 tons. Total value of the gold contained in the ore reserves on Dec. 31, 1929, is estimated at $47,819,398, compared with $51,210,235 at the end of 1928.

In the Schumacher shaft area, about 100 ft. of ore has been proved below 2,900 ft., of an average grade of about $8 a ton. On the 2,900 level and above, orebodies aggregating 1,200 ft. in length are in sight, as developed by drifts and drill holes. This ore will be available for milling later this year.

■

Remodel Utah Vanadium Mill

Remodeling of the U. S. Vanadium mill in Dry Valley, 10 miles south of Big Indian, San Juan County, Utah, is now being undertaken. Supplies are being hauled to the plant from Moab, according to E. F. Sutherland, who is in charge. This mill was erected several years ago to treat ore from the company's vanadium and carnotite deposits, but the influx of vanadium from Peru forced suspension of operations.

Nevada Con. Adds Large Tonnage to Ore Reserves at Chino

At Nevada Consolidated's Chino mine, near Santa Rita, N. M., prospect drilling south of the Sierra orebody, together with shovel operations in this vicinity in banks of the pit, shows a major extension of the orebody to the south, according to W. S. Boyd, assistant managing director of the company. Drilling is being continued. A complete calculation of additional ore shown by these holes has not yet been made, and will not be undertaken until the amount and value of this ore has been more thoroughly determined by further drilling. From results secured to date, an addition of about 20,000,000 tons of ore that can be mined by steam shovels, averaging more than 1 per cent copper, is certain. Continuation of the drilling will materially increase this tonnage, Mr. Boyd expects.

No development work other than that necessary for mining operations was undertaken at the company's Ray or Nevada mines. After including the 20,000,000 tons added at Chino, and deducting the 13,836,400 tons mined during 1929 at the three properties, total ore reserves on Dec. 31 are estimated at about 273,500,000 tons.

■

No. 6 Shaft at Mohawk Soon to Be Only Producing Unit

In all probability No. 1 shaft of Mohawk Mining will be mined out before the end of 1930 and the company will have to obtain its entire output of copper from its property in Michigan through No. 6 shaft, according to Theodore Dengler, general manager of the company. No. 5 shaft was abandoned at the end of 1929. Production is expected to show a considerable decrease in 1930. In the meanwhile, work of sinking the "E" shaft at the company's Michigan mine is being continued on a three-shift basis, with about 45 men employed. A 1,300-cu.ft. Sullivan compressor and a Fairbanks-Morse Diesel engine have been installed to facilitate the work.

Use of flotation at the Mohawk mill indicates a saving of 1.3 lb. of copper per ton, compared with results obtained before installation of flotation equipment. Despite treatment of a smaller tonnage than in 1928, this and other improvements permitted lowering the per-pound cost of producing copper to 7.316c., the lowest in any year since 1915.

■

U.V.X. Valuation Case Heard

The case of United Verde Extension Mining against the Arizona State Tax Commission for reduction of its assessed valuation was heard at Prescott, Ariz., on March 24 and 25 in the Superior Court of Yavapai County, Judge Fickett, of Tucson, presiding. F. E. Calkins, of Hollywood, Calif., and R. J. Cole, of Los Angeles, consulting mining engineers, testified as expert witnesses for the tax commission. John A. Church, Jr., consulting engineer, of New York, was the principal witness for the mining company. They were in close agreement on the facts and engineering principles involved, differing materially only on the method of valuation, which involved principles of law and equity rather than of engineering.

Mr. Church's total valuation of the mine and other property as of Jan. 1, 1929, was $7,300,000, based on what he estimated it could have been sold for at that date. The valuation of $11,000,000 by Messrs. Calkins and Cole was based on their estimate of the actual and probable earnings over the life of the mine. A valuation of $17,500,000 had been set by the tax commission.

The case is now in the hands of Judge Fickett, pending the submission of briefs by counsel for both parties. A decision will probably be handed down in July of this year.

■

Magma Proves New Orebody for 700 Ft. on 2,550 Level

Development of the new orebody of Magma Copper, west of No. 5 shaft, has shown a total length of 700 ft. on the 2,550 level. The same orebody has been proved for 450 ft. on the 2,200 level of the mine, which is near Superior, Ariz. On the 2,800 level the crosscut has not yet reached the orebody. Grade is lower than in the main orebody of the mine, but the mineralization is the same, largely chalcopyrite and bornite.

Crosscutting on the 2,800 level has cut the main orebody 820 ft. north of No. 5 shaft. Total width of the orebody is 24 ft., of which 7 ft. averages 4.9 per cent copper, 0.7 oz. of silver, and 0.01 oz. of gold to the ton. Average grade of ore mined in 1929 was 7.62 per cent copper, 3.9 oz. of silver, and 0.04 oz. of gold to the ton. Cost of producing copper increased to 9.987c. a pound in 1929, compared with 9.227c. a pound in 1928. This cost includes taxes and depreciation.

■

Ships Lead Ore to Douglas

Tombstone Extension, 2 miles southeast of Tombstone, Ariz., is shipping ore from development work at the rate of 25 tons daily to the lead smelter at Douglas. Ore is said to run about 20 per cent lead, with some silver, gold, and copper. Operation of the property was recently resumed by C. M. and H. H. D'Autremont, of Tucson, and W. E. Holt and W. H. Hasselgren, of Tombstone. Two shafts, 125 ft deep, were sunk during early development work. Shipments are coming from a crosscut from one of them. A new shaft recently encountered lead ore at 30 ft. and is still in ore at a depth of 60 ft.

■

Montana Mines to Enlarge Mill

An additional ball mill will be installed at the Spring Hill flotation plant of Montana Mines, near Helena, Mont., bringing capacity up to 350 tons of gold ore daily. The plant has been handling 225 tons of ore recently, and all of its equipment, with the exception of the fine-grinding machinery, is sufficient to handle 350 tons. Shipments of concentrate in March totaled fourteen carloads, as compared with seven carloads in January and February.

Daniel Jackling Foundation Established at Missouri

Establishment of the Daniel Jackling Foundation for Education in the Sciences and Arts pertaining to the Mineral Industry, at the Missouri School of Mines and Metallurgy, has been accepted by the board of curators of the University, acting upon a proposal made by D. C. Jackling, president of Utah Copper, and a graduate of the school. The Jackling Foundation involves enlargement of the Jackling Loan Fund now in operation, and creation of the Jackling Educational Fund, through contributions already made or to be made by him.

Mr. Jackling's present plans call for bequests totaling $600,000, of which $500,000 will constitute the Educational Fund and the remainder the Loan Fund. The loan fund is to be used largely for upper-class students. In fact, Mr. Jackling has asked that no aid should be extended to freshmen, except in unusual cases. During the sophomore year, half of the school expenses; during junior year, three-quarters of the expenses; and during the senior year, the entire expenses may be covered by loans to students. Mr. Jackling also expresses the hope that the foundation will not in any way interfere with appropriations to the school from the state.

■

Sunshine Installing New Hoist

Installation of the new 3,000-ft. hoist at the Sunshine Mining property, near Wallace, Idaho, by Coeur d'Alene Hardware & Foundry, is now under way, and may result in raising the production at the property to 500 tons daily. At present about 400 tons of silver ore is being handled daily, as compared with only 200 tons before the new 8-ft. Hardinge ball mill was installed. Shaft sinking will be resumed from the 1,300 level when the hoist installation is complete. Development at that depth has shown that the two Sunshine veins, the Yankee Boy and the Polaris, are only 15 ft. apart. Drifting east on the Polaris vein has shown ore 5 to 7 ft. wide and averaging about 60 oz. in silver to the ton. The Yankee Boy vein is of the same character but of lower grade.

■

N. M. Students on Field Trip

The senior class of the New Mexico School of Mines, at Socorro, N. M., in charge of Prof. A. S. Walter, left on March 21 on the annual field trip to properties in the Southwest. The mine and mill of Nevada Consolidated near Hurley, operations in the Silver City district, and metallurgical plants at El Paso, Tex., were inspected.

■

Build Mill at Swansea Mine

A 250-ton copper flotation mill is being constructed for the Swansea mine, north of Bouse, Ariz. The steel building is completed and the foundations are ready for the mill machinery. E. C. Lane, the present manager, sold his lease last year to American Smelting & Refining, after the mine had been examined by Julius Kruttschnitt, Jr., of Tucson, and F. E. Calkins, of Hollywood.

Ohio to Build Pilot Mill for Tailing-Dump Tests

Construction of a small pilot plant will be undertaken by Ohio Copper to test the possibilities of treating its tailing dump at Bingham Canyon, Utah, by flotation. The dump contains about 5,000,000 tons, averaging 0.47 per cent copper. Tests by J. B. Lain, of Reno, Nev., indicate that a concentrate averaging 10.5 per cent copper can be made from this material at a profit, according to Ira B. Joralemon, consulting engineer of the company. The pilot plant will check Mr. Lain's tests and, if they are successful, a 1,700-ton tailing re-treatment plant will probably be built. Its cost is estimated at about $120,000 and the management anticipates a return of about $150,000 annually for seven years from its operation.

Development work in the mine during the last year has proved that geological theories concerning mineralization are correct. Most of the work has been done on the 700 level in the Commercial and Jordan limestones. Small bodies carrying copper, lead, silver, and gold have been struck, and the management expects that a continuation of development will reveal large orebodies occurring under similar conditions as those prevailing in adjoining properties.

■

Two High-Grade Gold Strikes Reported in Colorado

Two gold strikes, one in Boulder County and the other in the Idaho Springs district, have been reported from Colorado. Both are said to be high grade, and the one in Boulder County has been described by J. T. Joyce, State Mine Commissioner, as one of the most important discoveries in Colorado in recent years. It was made on the Tambourine property, 7 miles west of Boulder, after driving a tunnel 150 ft. It is 4 ft. thick and has been followed for a distance of 50 ft. Where cut the vein is only 50 ft. below the surface. The property is owned by the Boulder National Bank and is operated under lease by O. P. Pherson.

The other strike was a narrow stringer of high-grade sylvanite found in a stope of the Skyrocket mine, operated by Idaho Springs Gold. C. W. Lerchen is in charge of operations. A strike of sylvanite was made in the Skyrocket about twenty-five years ago that yielded high-grade ore of a similar character.

Another Colorado gold mine that has attracted some attention is the London property, 3 miles from Alma, which shipped 26 carloads of gold ore, said to average 5 oz. in gold to the ton, to the Leadville smelter during February. W. Kennon Jewett now owns the London mine. Ore is being extracted from the Dempsey claim, where a 6-ft. orebody has been developed.

■

Push Work at South Mountain With New Surface Plant

Completion of the surface plant at the South Mountain property of the Exploration Company of California, near Bullion City, Idaho, has permitted vigorous advancement of development work. A crosscut has been extended 100 ft. into the Laxey orebody, with the face in ore assaying 1.2 per cent lead, 1.5 per cent copper, 30 per cent zinc, 0.02 oz. of gold, and 20 oz. of silver per ton. The ore occurs in a hedenbergite formation. The Sonneman adit has been driven 500 ft. toward the Golconda vein, which it is expected to cut in the near future. Another adit will be driven 250 ft. lower.

Unusual difficulties were met in transporting the surface plant equipment over poor roads and with bad weather to the property from Caldwell, 85 miles away, but the entire job, including construction, was completed in less than a month. Six trucks and 40 horses were used. The equipment includes a 750-cu.ft. Ingersoll-Rand compressor and a 190-hp. Winton gasoline engine. J. G. Scott is superintendent in charge of operations. Arthur Johnson, of the Union Iron Works, Spokane, Wash., supervised the construction program.

Imperial Mines Plans Mill for Low-Grade Nevada Gold Ore

South of Battle Mountain, Nev., Imperial Mines Corporation, a Nevada company, controlled by H. Z. Peters and associates, plans to construct a 500-ton mill on a gold property that it has obtained from C. W. Birum. Over an area estimated to be 1,500 ft. long and 95 ft. wide, assays indicating gold ore averaging about $6 a ton have been obtained. Three crosscut tunnels have been driven at depths of 130 to 180 ft. The ore occurs in a quartzite schist formation and is said to carry free gold. Power-shovel mining of the deposit is said to be practicable. The gold-bearing formation will be tested further.

■ ■ ■

Several Coeur d'Alene Mines Close and Utah Properties Decrease Shipments

FOUR of the lead-zinc producers in the Coeur d'Alene district suspended operations in the middle of March as a result of the drop in lead after similar declines in the price of silver and zinc. None of the large Utah mines have completely closed, but several have made large cuts in output. The slight improvement in the lead price in the last two weeks of the month, coupled with the belief that further improvement will come eventually, has prevented any further suspensions. The other important lead-mining district in the United States—the southeast Missouri field—has been operating on a basis of 10 per cent curtailment since the fall of 1929, and no further cuts have been announced.

Of the mines that closed in the Coeur d'Alene district, the Star property of Sullivan Mining was the largest producer. About 125 men were laid off, with 75 being retained on development. Production from the property in 1929 was 114,035 tons of ore, from which 4,436 tons of lead and 7,728 tons of zinc were recovered. Installation of the new hoist at the Hecla shaft, through which Star output is handled, has increased capacity to 1,000 tons daily. Development work being done at the property is principally the 2,800-ft. raise being put up from the 4,000 level to the Moffitt tunnel. The raise is now about 800 ft. from its objective. It is of four compartments and will improve the ventilation and ore-handling systems.

The three other properties to close in the Coeur d'Alene district were the Tamarack & Custer, Golconda, and Sherman mines. The first two had been producing about 200 tons daily and the last about 150 tons. About 75 men have been laid off at each of these properties, small forces being retained for development work. Federal, Hecla, and Bunker Hill, the three largest producers, are maintaining normal payrolls and production.

Curtailment has been general in Utah, although mines carrying high zinc content have cut more than others. The low silver price has also been a large factor in cutting profits. Although in certain cases working forces have been greatly reduced, where possible mining companies have shifted miners from production to development work rather than discharge them.

Utah Copper, at Bingham, has cut production to about half of what it was last year at this time. Other mines in the Bingham district have increased production of copper ores to offset the decrease in lead-zinc ore shipments, so that the camp's ore production does not actually show the decrease in production of lead and zinc that has taken place. In the Tintic district, Tintic Standard and North Lily are shipping smaller tonnages than formerly. Eureka Lilly, which has struck high-grade ores of diverse contents, is shipping more than at this time last year.

Park Utah and New Quincy have made large cuts in production at Park City. Output of the former is about 50 per cent and of the latter about 25 per cent of the average in 1929. Silver King Coalition, with the new economies resulting from mill remodeling, and with an excellent grade of ore, is producing little below normal. Beaver County output is unchanged. Tintic Lead could double its output as a result of recent ore discoveries, but attention is being centered on development until metal prices improve.

■

Continued Gain at North Butte

Production of copper ore from the Granite Mountain mine of North Butte, in the Butte district, was 9,250 tons in February, or an average of 330 tons daily. Shipments in January were 8,800 tons, an average of 280 tons daily. The February shipments were the largest since the mine was reopened in 1929. On the 3,200 level of the mine, the company has opened a new high-grade orebody. At its Main Range mine the company is continuing exploration of ground east of the Continental fault.

■

Silver Shield Exploring Claims

At the West Tintic holdings of Silver Shield Mining, the lower workings of the Copper Jack mine are being unwatered. A connection will soon be made with the upper levels where copper ore was opened some years ago, according to H. S. Joseph, president. Churn-drilling operations on the property are also well under way. The first hole has been drilled to a depth of 354 ft., and a second hole has been spudded in. From eight to ten holes will be put down in an effort to locate other copper deposits. At the company's Independence property, in the East Tintic district, two shifts are sinking the main shaft, which has passed the 1,100 level. Recent assays taken from material at the bottom of the shaft indicate low values in copper.

Southwestern and Wheeler Sign Russian Contracts

A delegation of the United Non-ferrous and Precious Metals Industries of the Soviet Union, headed by V. S. Gulin, vice-chairman of the board, has concluded a series of agreements with American firms providing for technical assistance in the design, construction, and operation of several non-ferrous metal plants, according to an announcement made by the Amtorg Trading Corporation.

A contract was concluded with the Southwestern Engineering Corporation, of Los Angeles, to act as consultants in the preparation of projects and the construction and operation of new and existing concentration plants in the Soviet Union. This agreement was signed on behalf of the Giprotzvetmet (State Institute for Designing Non-ferrous Metal Plants) by Mr. Gulin and N. S. Nharitonenkov, director of the Giprotzvetmet, who is also a member of the delegation of the Soviet non-ferrous metals industry visiting the United States.

An agreement with the Radiore Company, of Los Angeles, was made on behalf of the Geological Survey Department of the Supreme Economic Council of the U.S.S.R. E. J. Atckison, vice-president of the Southwestern Engineering Corporation, signed the contracts for both companies.

A contract between the United Non-ferrous and Precious Metals Industries and Archer E. Wheeler and associates has been ratified.

■

Alaska Juneau Acquires More Ground in Taku River Area

Alaska Juneau has located 40 additional claims along the Tulsequah River, below its Manville group, in the Taku River district of British Columbia, and has also taken an option on the Tulsequah Chief group developed by United Eastern in 1929. About 25 men are now employed by the company, with which Treadwell Yukon is associated, in developing on the surface the complex outcrops, carrying zinc, silver, copper, gold, and lead, that have been discovered in this area. The grade on the Manville group is better than on the Tulsequah Chief, but development at the latter includes more underground work. On both groups, copper and the precious metals tend to concentrate in the center of the orebodies. Because of the existing condition of the zinc market, the company may prefer to mine this higher grade ore only at present, leaving the material in which zinc predominates for extraction later.

■

Falconbridge Continues Drilling

Notwithstanding early disappointments, drilling from the 1,000 level of the Falconbridge Nickel mine, near Sudbury, Ont., to explore the deeper horizons for possible copper enrichment, is being continued. Three deep holes have been put down to date. Two of these cut the contact around 2,000 ft. and the third held out at about 1,750 ft., vertical depth. In the two deep holes, one opposite the shaft and the other 700 ft. west of it, massive ore was found over comparatively narrow widths. The dip of the orebody, instead of flattening, as expected, is almost vertical at these horizons. A fourth hole has been started to cut the contact area about 350 ft. west of the shaft and at 2,000 ft., vertical depth.

During March the rated smelter capacity of 250 tons a day was exceeded, and at present the plant is treating 275 tons daily. Matte averages around 78 per cent of combined nickel-copper content, or about 24 per cent copper and 54 per cent nickel. From ore averaging about 4 per cent combined nickel-copper, more than 300 tons of matte was shipped to the Falconbridge refinery in Norway in March. The refinery, also on a regular operating basis, is producing nickel 99.95 per cent fine.

■

Miners Operating Purissima Grande; Panuco Closed

Low silver prices have forced suspension of operations by Cia. Minero de Panuco, in Mazatlan, Mexico, and operation of the Purissima Grande property, in the Pachuca district, Hidalgo, by the miners. The Purissima company claims that it has lost 500,000 pesos in operations during the last few years. The workers will operate the property on a profit-sharing basis, with the mining company to get 2 per cent of the profits, if there are any. About 200 men are at work, on twelve-hour shifts. The management of the Panuco company hopes to be able to resume operations in June. Several hundred men were employed. Lack of power was a contributing factor in the suspension at this property.

■

Real del Monte Completes Centralization at Pachuca

At the beginning of March, Real del Monte, Mexican subsidiary of U. S. Smelting, Refining & Mining, started handling the entire output of its Pachuca mines in the Loreto mill, at Pachuca, Hidalgo, Mexico. The plant now has a capacity of 3,500 metric tons daily. Formerly about one-third of this total was handled in the Guerrero mill, near Real del Monte. The Guerrero mill has been closed. Transportation for most of the ore is now effected through the 5,500-m. haulage tunnel, driven last year to supplant the cable tramway. During 1929, according to C. A. Hight, president of U. S. S. R. & M., development in known orebodies substantially helped to maintain ore reserves. A slight increase was shown last year both in tonnage milled and in grade of ore, so that silver production was higher than in 1928. The reduced costs that are expected from the new, centralized plan of operation, on which $1,210,122 was spent in 1929, will help to offset the present low price of silver.

■

New Converter at Carteret

A Peirce-Smith converter is being installed at the copper smelter of U. S. Metals Refining, subsidiary of American Metal, at Carteret, N. J. It replaces an old converter of the Great Falls type, installed in 1921. The plant has a capacity of 200,000 tons of charge annually.

Patiño Reserves Increased Despite Record Extraction in 1929

Despite extraction of 795,052 metric tons of ore in 1929, Patiño Mines & Enterprises increased reserves of ore at its property near Uncia, Bolivia, from 1,605,637 metric tons of 4.45 per cent tin at the end of 1928 to 1,964,864 tons of 4.2 per cent tin at the end of 1929, according to J. C. Pickering, general manager of the company. Total accessible workings in the mine are now 87 miles long. At no time has any part of the mine been abandoned, as geological studies are constantly suggesting new points of attack.

The new sorting plant at the portal of the Siglo XX tunnel was put in service at the end of the year, and has since operated successfully. Ore is now shipped to the concentrator at Catavi by rail instead of cable tramway. The mill has been enlarged to a capacity of 2,200 metric tons daily, and additional regrinding, classifying, and thickening equipment is being installed. Recovery has been improved considerably, in 1929 only 0.83 per cent tin being contained in the tailing, as compared with 1 per cent in 1928.

■

Callahan Zinc-Lead to Center Work on New South Vein

During 1930, Callahan Zinc-Lead will confine development work to the new south vein at the Galena property, near Wallace, Idaho. A crosscut is now being driven to this vein on the 1,000 level to prove its continuation from the 600 to the 800 level. On the upper of these two levels, ore occurs in short lenses for a distance of 350 ft. It averages 9.4 per cent lead and 6.3 oz. in silver per ton, with no zinc, and is about 8 ft. wide. On the 800 level, the vein was 25 ft. wide, of which 6.5 ft. assayed 19.3 per cent lead and 10.8 oz. of silver per ton, according to C. W. Newton, general manager of the company. Only a limited amount of drifting has been done on this level to date. Production is now about 200 tons of concentrate monthly.

■

Government to Build Railroad to Lake George Mining

An agreement for construction of a 24-mile railroad from Bungendore, New South Wales, Australia, to Captains Flat, where Lake George Mining is developing a lead-zinc property, has been reached between the company and the Provincial government. Actual construction will be undertaken by the government. In return the company agrees to use the government railroad for 53 years, provided operations are continued for that length of time, and to produce 300,000 tons of ore annually.

■

Ahumada Lead Stops Pumping

Pumping operations on the Nos. 7 and 8 levels of Ahumada Lead, at Los Lamentos, Chihuahua, have been suspended, as the decrease in the price of lead makes the cost of pumping 100,000,000 gal. of water monthly out of the workings too great. Some production is coming from the Nos. 4 and 5 levels, but the volume has been greatly reduced. No attempt will be made to work the lower levels until metal prices improve.

Frood Smelter May Be Ready to Handle Ore in July

Progress of construction of the 5,000-ton smelter of International Nickel at Copper Cliff, Ont., indicates that the plant will be ready to operate about the middle of July. Tests have already been made on the 700-ton coal-grinding plant, and tests of the new 510-ft. smelter stack will be made within a few weeks. Smelter equipment includes five 1,000-ton reverberatory furnaces, thirty 10-hearth Herreshoff roasters, and eight 13x35-ft. converters. Structural steel work on the new 8,000-ton concentrator is almost completed. The plant will treat practically the entire Frood mine output, as well as much of the ore from the company's other mines. Selective flotation will be used to separate part of the chalcopyrite from the remainder of the ore.

Although for some time efforts have been directly chiefly toward development of the Frood mine between 2,000 and 2,800 ft., a winze is now being sunk and diamond drilling started on deeper levels. Mond Nickel, prior to amalgamation with International Nickel, opened up part of the Frood mine at 3,100 ft. from the No. 4 shaft. At the Levack mine, rapid progress is being made with reconstruction of the surface plant destroyed by fire last December. The new steel headframe is in place, and installation of machinery has been started. Production from the property may be started before July, the date indicated in official statements.

■

Dome to Rebuild Mill

Semi-official announcement has been made that Dome Mines will proceed immediately with construction of a new 1,500-ton cyanidation mill to replace the plant which was destroyed by fire in October, 1929, at its properties in the Porcupine district of Ontario. Plans and estimates have already been prepared. Because of short known life of the property, cheap construction will be used. Elimination of amalgamation will be the only important change in the flow sheet.

■

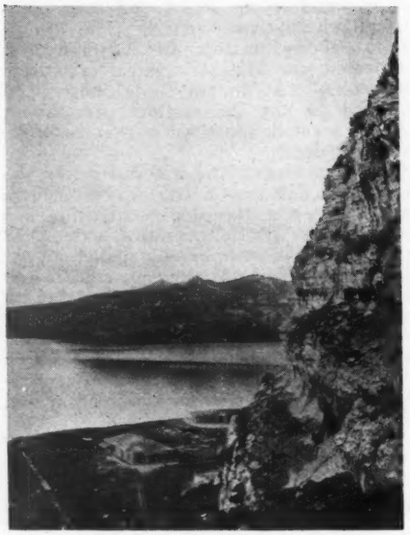
Atlas Mining Strikes Ore

About 9,000 ft. from the portal of its tunnel, Atlas Mining has struck silver-lead ore, 8 ft. wide, at its property in the Coeur d'Alene district, Idaho, according to W. Earl Greenough, vice-president of the company. The strike was made on March 22. Two veins, carrying mineralization, were encountered early in February. Drifting and crosscutting to the east disclosed the ore, which is in the so-called Bird vein about 110 ft. from the point at which the vein was first cut. The ore is clean lead sulphide, with no zinc.

■

Granby Bonds Okanagan Claims

Granby Consolidated has bonded a large group of claims at Siwash Creek, B. C., on the east side of Okanagan Lake, from Okanagan Copper Mining. Exploration of the property by the latter company has exposed chalcocite ore in several open cuts and short tunnels over an area 600 ft. wide and more than a mile long.



Lake Pun Run, in Peru, the highest navigable lake in the world, used for ore transportation from the Minas Ragra property of the Vanadium Corporation. Some of the camp buildings are shown.

Noranda and Waite Check Drill Results by Lateral Work

Crosscutting at the Waite-Ackerman-Montgomery and Noranda properties, near Rouyn, Que., has verified drill results obtained at these two copper-gold producers. A crosscut on the 550 level at Waite has cut ore where drilling indicated 51 ft. of 6 per cent copper. The 700 level crosscut has not yet reached the ore indicated by three drill holes. At the annual meeting statement was made that the present development work will determine the scale of production in the future. At present about 4,000 tons of ore is being shipped to the Noranda plant monthly.

Noranda has drifted for 99 ft. on the new gold orebody found 150 ft. southeast of No. 5 shaft, the president stated at the annual meeting on March 28. The average grade was $15.50 a ton. Two new drill holes, one at 975 ft. and the other at about 900 ft., averaged $12.75 and $12.88 a ton. The orebody is expected to extend to the 725 level and to form an important addition to reserves of siliceous fluxing ores for smelter operation. Smelter capacity will be maintained at 2,000 tons daily. Cost of increasing concentrator capacity to 1,000 tons is given as $350,000. The new main shaft is down to 1,500 ft., and four new levels are being opened below 975 ft.

■

Quincy to Open Up 91 Level

Nos. 2 and 6 shafts of Quincy Mining, in the Michigan copper district, are now down to the 91 level, and crosscutting to the lode has been started at that depth. Development on the 90 level showed about 700 ft. of better than average grade ore north of No. 6 shaft. In No. 8 shaft, a crosscut is being driven on the 81 level, the bottom of the shaft. Developments in this area have been encouraging and assure the company of three producing shafts. At the Quincy mill, flotation has reduced losses to 2 lb. of copper per ton of ore treated, and further improvements are anticipated.

C.M.& S. Obtains Best Results at Coast and Big Missouri

Coast Copper and Big Missouri responded most favorably to development of the many properties that Consolidated Mining & Smelting had under option or control during 1929, according to the company's annual report. Developments at Coast Copper, on Vancouver Island, B. C., indicate a sufficient tonnage of ore to provide for mill construction and transportation facilities. A winze is now being sunk from the 1,200 to the 1,600 level at this property. Electric haulage has been installed at the mine.

Exploratory work at Big Missouri, in the Portland Canal district of British Columbia, indicates considerable quantities of ore. Further work will have to be done to determine the full extent of the orebodies before the scale of operations is decided upon. A small pilot mill will probably be built this year to provide large-scale sampling. The mine is said to offer some promise of becoming an important gold producer.

Of the other properties in which the company is interested, Northern Lead-Zinc, holding ground on Great Slave Lake, in the Northwest Territory, has proved deposits of lead and zinc over a large area. The known deposits occur near the surface and, although substantial thicknesses of lead and zinc sulphides have been proven, oxide ores are also extensive and may present serious difficulties in metallurgy.

At the Kinman property, on Nimpkish Lake, Vancouver Island, B. C., work has been disappointing in that it has failed to disclose the joining of several promising surface exposures as one orebody at depth. Copper and zinc outcrops at this property were extremely impressive. Work is being energetically continued. Another copper property at which considerable work is being done is the Dillabough group, north of Dean Lake, Ont. One vein near the north boundary of the property has been traced for 3,600 ft. Surface work has shown 2.5 per cent copper and 30c. of gold per ton over an average width of 7 ft. for a distance of 600 ft. Because of the high silica and low sulphur content, the ore would be particularly adapted to concentration.

■

Montana Lead Mine Sold

According to G. B. Conway, mining engineer, of Helena, the Hecla lead mine, near Melrose, Beaverhead County, Mont., has been sold to the Foundation Company of Utah for a consideration reported to be $500,000. The Hecla property was first opened in 1873. Production of lead, silver, zinc, and gold is said to have totaled $20,000,000 since then. Mr. Conway has been operating the mine since 1928.

■

New Hoist for Britannia

An Ingersoll-Rand electric hoist has been ordered to facilitate development work at the Britannia property of Howe Sound, in western British Columbia. This work is being done to determine the advisability of extending the 4,100 level haulage tunnel into or under the chief orebodies, which have now been developed only to the 2,700 level. A definite decision will probably be reached by the end of this year.

American Zinc Institute Will Hold Annual Meeting

The twelfth annual meeting of the American Zinc Institute will be held at the Statler Hotel, St. Louis, Mo., on April 14, 15, 16. General discussion will be directed toward consideration of the reports of the various committees of the Institute, developments in the several zinc producing districts, and the principal market for zinc.

On Monday, April 14, Dr. Hugh P. Baker, manager of the Trade Association Department of the U. S. Chamber of Commerce, will address the meeting on trade-association endeavor. The following day, George A. Charls, president of the National Association of Flat-Rolled Steel Manufacturers, will discuss the utilization of zinc in galvanizing; William A. Willis, manager of the Copper and Brass Research Association, will speak on the consumption of zinc in brass manufacture: Robert M. Curts, technical service division, New Jersey Zinc Company, will outline developments in zinc die-casting; and Dr. H. W. Gillett, director of the Battelle Memorial Institute, will discuss the value of research in non-ferrous metals. A motion-picture film dealing with the production of zinc oxide will be shown. Entertainment features will include a smoker on Monday evening, a golf tournament, and a banquet on Tuesday.

■

New York Engineers to Hear About Licensing

Mining engineers in the vicinity of New York City will have an opportunity to hear of the latest developments in engineer licensing legislation, and to offer suggestions for uniform state laws on this subject, at a dinner meeting of the local section of the A.I.M.E. on Wednesday, April 23. Arthur V. Sheridan, president of the New York State Society of Professional Engineers, and others will speak. All interested are welcome. Reservations are being made by L. F. Strobel, Room 5002, 233 Broadway; phone Fitzroy 9668.

■

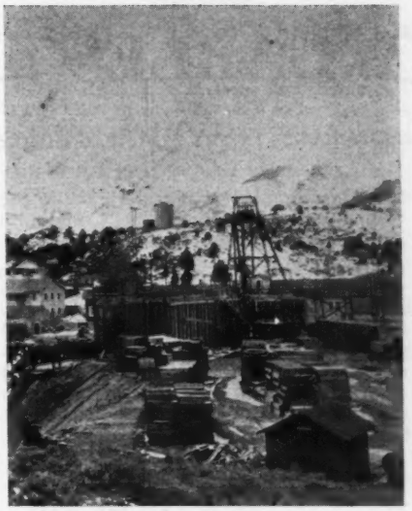
To Develop Eureka Mines

Golconda-San Juan Mines will start development of its properties near Eureka, Colo., next month. This corporation, organized by A. J. Faerber and associates, all of Davenport, Iowa, has acquired the Golconda mine, in Hinsdale County, and the San Juan, Crater, and Empire claims in San Juan County.

■

Bagdad Copper Enlarging Mill

Capacity of the flotation plant at Bagdad Copper, near Hillside, Ariz., is being increased from 50 to 200 tons of ore daily by Southwestern Engineering. The Bagdad mill was originally used for experimentation purposes, but it is now being enlarged to handle the increased output of ore from development work, preparatory to the construction of the final plant, which will probably handle 5,000 tons of ore daily. A new operating shaft is being sunk on the property and a townsite is being prepared 2 miles from the present mine workings. Drilling has indicated the existence of large tonnages of sulphide and oxide ores, averaging about 1.2 per cent copper, at this property.



Main shaft at the North Lily silver-lead property, in the Tintic district, Utah, where a gold strike has recently been made

Trade and Industry Turn Upward

ROBERT M. DAVIS
Statistical Editor,
McGraw-Hill Publishing Company

The closing weeks of the first quarter of the year witnessed a distinct upward trend in general trade and industrial operations. Materially increased general construction contracts awarded in practically all sections of the country during the last few weeks, easing of money rates to the lowest point since 1923, improvement in the prices of farm staples, and trade and industrial betterment in one way or another in practically all sections of the country brighten the outlook. In spite of the undoubted unemployment in most industrial centers, the sum total of industrial activity at the close of the first quarter, as reflected by the various indexes available, is not really poor, suffering chiefly by comparison with the forepart of last year.

"Current business is only fair and collections are slow, but both are decidedly more favorable than we thought possible last November, and we fully expect a material improvement as the spring opens up." Such is the composite view of the country's business and industrial men I obtained during a 17,000-mile tour just completed, covering every section of the United States. The American business man is psychologically inclined to regard the present fair condition of production and trade as in a measure satisfactory. At any rate, little pessimism exists among business men as to the future—once the spring trade demands get under way. With most of the industrial groups, including general construction, now definitely on the upgrade, and general trade expanding with the unusually late spring demands, outlook for the remainder of 1930 is favorable. Omitting the first quarter, 1930 should be a year of stability in American trade and industry.

Miami Reduced, Inspiration Increased, Costs in 1929

Costs at Miami Copper were reduced from 11.9c. a pound in 1928 to 11.74c. a pound in 1929, whereas at Inspiration they increased from 10.66c. to 11.13c., according to the annual reports of these two large copper producers in the Globe-Miami district of Arizona. The reduction at Miami results largely from the economies made possible by increasing mill capacity, whereas the increase at Inspiration reflects increased labor and repair costs.

Operation of the new plant for treating primary slimes removed from leaching ores at Inspiration is expected to start in May. About 600 tons will be handled daily. Experimental work in the electrolytic plant has indicated that by closer spacing of the anodes, copper production capacity can be increased 20 per cent, and this change is now being effected. At the mine, few changes of importance have been made. Development of the Southwestern Miami property, acquired last year, has been started through the 1,200 level of the Live Oak division. Production from the west section of the orebody started in January. An inclined shaft is being sunk to the No. 6 level of the Live Oak section. It will handle men and supplies and furnish ventilation for the territory south of the area from which production is now being obtained.

At Miami, only a few changes in the mill remain to be made to complete the program of expansion, on which $2,316,605 was spent in 1929. Milling costs during the last three months of 1929, when capacity of 17,000 tons daily had been attained, were only 32c. per ton of ore, compared with 36c. per ton for the entire year, and 38c. per ton in 1928. The new high-steam-pressure installation has alone reduced power costs 40 per cent. Yield of copper per ton of ore in 1929 was 11.7 lb., of a copper content of 16.6 lb. The sulphide copper content was 13.7 lb. No new ore was developed at the mine during the year, and the reserves were decreasd by almost the tonnage mined to 90,391,980 tons, averaging 0.88 per cent copper, and 7,000,000 tons of mixed ore, averaging 1.83 per cent copper.

■

Copper Range Drills Two Areas

Drilling at its Trimountain and Baltic mines, in Michigan, is being undertaken by Copper Range to test mineralization at depth. Developments at depth in both properties have been poor, and the drilling will be carried to 1,500 ft. below the present bottom levels of the properties. Copper Range production is still considerably curtailed. At the mill, two sections have been provided with flotation equipment, and further additions will be made.

■

St. Joe to Build in Argentina

Compañia Minera Aguilar has been organized by St. Joseph Lead to build an 800-ton mill at properties in the Aguilar district, Province of Jujuy, Argentina. In addition to the mill, which is expected to be in operation in 1932, according to Clinton H. Crane, a 35-mile railroad from Tres Cruces to Aguilar, a Diesel power plant, and a townsite will be built.

EXCLUSIVE

CABLES

FROM CORRESPONDENTS IN THE PRINCIPAL MINING CENTERS

Rio Tinto Declares Bonus; Panama Fully Financed

London, March 29.—Rio Tinto has declared a bonus payment of 5 per cent on its outstanding ordinary shares, together with regular semi-annual payment of 25 per cent. This makes the total dividend payments on profits in 1929 55 per cent, as compared with 40 per cent in 1928. Par is £5 per share. In addition, the company carries forward to surplus account for 1929 a total of £203,651, as compared with £167,372 carried forward in 1928. An issue of 50,000 new shares of ordinary £5 par has been made at £50 a share. This brings the total of ordinary shares up to 475,000.

. . . . Hugh Marriott, director of Panama Corporation, cables from Panama that mining developments are encouraging, especially at Hatillos. This news is presumably a preliminary to the issuing of 500,000 additional shares within the next fortnight. At present 1,494,800 shares of £1 par are issued. The entire issue is said to be underwritten in London.

. . . . The diamond position looks better as the result of an agreement between the government of the Union of South Africa and private producers. Jagersfontein, one of the big producers, has passed its dividend, owing to the depression in the diamond market, which is attributed to the Wall Street crash. Substantial recovery is predicted, however. The attempts to set up a diamond-cutting industry at Cape Town have been unsuccessful, and some of the factories are closing.

. . . . Central Provinces Manganese Ore, which owns about twenty mines in central India, had a better year in 1929 than in 1928. Profit for the year was £306,135, against £296,260 in 1928. A final dividend of 15 per cent was declared, bringing total dividend payments up to 22½ per cent, which is the same as in 1928. The balance carried forward was £31,526.

. . . . Copper is still considered here to be in an unsatisfactory position. Control of the metal is not watertight, as outside producers are underselling the pegged price.

. . . . The position of tin is still obscure. Foreign interests, among whom Simon I. Patiño is mentioned, have bought large holdings in English Malayan companies and demand representation on the various directorates. Meetings of several companies have been called at which five-year terms of office for directors will be proposed to prevent foreign control. Rumor says that an effort may be made to disorganize the Straits Trading Company, Ltd., which operates large tin smelters in the East. On the other side of the ledger, Rand Mines is becoming interested in tin mining in Bolivia.

. . . . Burma Corporation will not be much affected by the silver duty of four annas an ounce imposed by the Indian government, as it is balanced by an excise impost that will prevent the company from selling its production locally at more than the world price.

. . . . Russia is reported to have secured credits to purchase Chilean nitrate for its extensive agricultural program. Australian gold producers will receive a premium equal to the difference between the London and Australian value of gold as part of the program of stimulating gold production in that continent.

■

Government Relief for Tin Mines Considered in Bolivia

La Paz, Bolivia, March 29 — The position of the majority of the tin producers in Bolivia is very difficult, as the price of the metal continues low. Most of the mines are endeavoring to avoid shutdowns, however, as the feeling that the situation will improve in the future is general. The Bolivian government is considering relief for the mines, which are the principal sources of its revenue. A reduction in miners' wages and decrease in freight rates on mining materials imported into the country are suggested. A drop in the Bolivian exchange has also been suggested, as the mines are paid for their production largely in English currency.

. . . . Operation of the new Huanuni tin dredge, about 35 miles southeast of Oruro, has been started. The plant will dredge an area with an estimated reserve of 15,000,000 cu.yd. at the rate of about 1,400,000 cu.yd. annually. This property is the only tin placer deposit, aside from the Arafila property of Caracoles Mining, on which work is being done in Bolivia.

. . . . The San Juan tin-silver property, under developed by Newmont Mining, American holding and exploration company, is showing favorable results.

■

Wiluna Shaft Below 600 Ft.; Ora Banda Field Promising

Kalgoorlie, Western Australia, March 29—Wiluna Gold has sunk the main haulage shaft at its property near Meekatharra to a depth of 619 ft. Although the large electric hoist has not yet been installed, mine development has been pushed rapidly and the maximum requirements for milling operations are now fully developed. Work is being done on the 290 and 450 levels, as well as several intermediate sublevels. Installation of milling machinery for the 1,400-ton plant was started early in March, but production probably will not start until late in the year.

. . . . Some activity is noted in the Ora Banda field, where operations have long been on a small scale. Good developments are reported in the Royal Princess mine and resumption of suspended exploration work in the Sand Queen mine is proposed. The state government has operated a small five-stamp mill at Ora Banda for several years.

. . . . Exporation north of the old workings in the lower levels of the North Kalgurli mine has yielded satisfactory results. Although equipped with a twenty-stamp mill, the property has been on a development basis for several years, as the upper workings have been practically exhausted. During the last fiscal year, ended June 30, 1929, a loss of £21,761 was recorded. To finance further development, 65,249 shares were issued at 3d. per share late last year. Estimated ore reserves were only 170,000 tons averaging 30s. per ton in grade, according to the last available estimate.

. . . . Lake View & Star is continuing its extensive development program. Operations in February are estimated to have shown a profit of £3,150, as contrasted with a profit of only £7,939 for the sixteen months ended June 30, 1929, the last official report. The first section of the new flotation plant is expected to start in May. Total production from the East Coolgardie field in February was 24,506 oz., an improved showing over last year.

■

Rhodesian Companies Expected to Confer in London This Month

London, April 1.—A conference of the heads of the several companies interested in Rhodesian copper properties is understood to have been scheduled for some time this month. The meeting will be held in London. A. Chester Beatty, chairman of the important Selection Trust group of companies, is returning from his winter vacation, and Sir Ernest Oppenheimer, chairman of Anglo-American Corporation, which has very extensive interests in Northern Rhodesia, will return from South Africa, where he is attending the Empire Mining Congress. The matters that will be discussed at this conference are subject to considerable verbal speculation. Among other rumors, the possibility of joint action in construction of a central smelting and refining plant, to treat concentrate from the four or five mills that are now definitely decided on, is particularly prominent. Decision to further expand hydro-electric power plans is also considered likely. Altogether, the conference, if it is held, will certainly attract a great deal of attention from mining men and investors.

. . . . Mindola hole No. 14 has been completed. It struck ore at 1,239 ft., the greatest depth yet attained in the Mindola orebody, and showed a true width of 9.9 ft., averaging 3.43 per cent copper. This hole does not add to the length at Mindola, but indicates the depth to which the width and grade of the orebody on this important section of Bwana M'Kubwa's N'Kana holdings persist. A total of 62 holes have now struck ore at the N'Kana property, and, although definitely outlined ore is 56,000,000 tons, actually about 100,000,000

tons of 4 per cent copper has been indicated. Materials and equipment for the 6,000-ton N'Kana concentrator have already been purchased, and much of it is now being delivered at the bank of the Kafue River, awaiting completion of the railroad bridge some time this month, when extension of transportation facilities to the property will be made possible.

. . . . A. D. Storke, of the London office of Rhodesian Selection Trust, has arrived in Africa to hasten construction of the several plants in which his company is interested, principally Roan Antelope and Mufulira. A contract has just been let by the latter company for the construction of seventy additional houses. Preparations for erection of the concentrator at this property are making good progress.

. . . . Production of sulphide copper concentrate from the mill of Southern Rhodesia Base Metals at the Alaska mine was 535 tons in the first quarter of 1930. Average grade of the concentrate was 67 per cent copper. A segregation-process plant, for the treatment of 50 tons of mixed oxides and sulphides daily, will also be erected at the Alaska mine to supplement the 150-ton flotation unit. Minerals Separation will build the plant. The segregation process was evolved by the latter company and was described in *Engineering and Mining Journal* of Nov. 16, 1929. The Minerals Separation dividend rate has been increased to 25 per cent from 12½ per cent semi-annually.

■

Alluvial Gold Areas Attracting Attention in Australasia

Melbourne, March 29.—Several new projects for working alluvial gold areas in Australasia have been disclosed within the last few weeks. Preparations are being made at Mitta Mitta, near Mount Benambra, in eastern Victoria, to work an alluvial gold area containing 3,500,000 cu.yd., said to average from 2s. to 7s. a cubic yard. This deposit will be worked by sluicing at the rate of about 30,000 cu.yd. a month. Another attempt will be made to win gold from the famous Kawarau River, in New Zealand, from which £20,000,000 in gold has been obtained in the past by dredges. The new project, as outlined, would involve great engineering developments, including the draining and laying bare of the river bed. A prospecting party for Papuan Gold Areas, Ltd., has pegged 1½ miles of ground along the bank of the Tiviri River, in Papua. Good results from development work through shafts are reported.

. . . . Unless metal prices improve, Broken Hill Proprietatry will close its mine in the Broken Hill district on Sept. 1. About 700 men will be thrown out of work at this silver-lead-zinc property. The mine was reopened only last September, after having been idle since 1927, and shipments of about 2,500 tons of ore weekly have been made to the Sulphide Corporation mill. Treatment of oxidized tailing by the Henderson process will probably be continued, however. Only lead concentrate is produced from the tailing plant, which handles material averaging about 4 per cent lead and 1.8 oz. of silver to the ton.

. . . . Nine American shift bosses for Mount Isa have arrived in Queensland. Following heavy rains, the dam at Rifle Creek is now full and sufficient water for two years' operation of this big lead-zinc enterprise is assured. The new Mount Morgan company, known as Mount Morgan, Ltd., which has a capital of £200,000, will mine and treat ore lying above the 450, or Linda, level of the property at Rockhampton, Queensland. A large tonnage of gold-copper junore has been proved below the Linda level, but evidently no attempt will be made to extract it.

. . . . Promising discoveries of osmiridium-bearing veins have been made in serpentine formation at Adamsfield, Tasmania. The metal is being separated from the gangue by crushing.

. . . . Restriction of tin output is being practiced by 134 English-controlled companies in the East and in Africa, as well as by 60 Chinese plants in Malaya, according to the most recent computations. The aggregate curtailment of the various associations is reported here to be about 24,000 tons annually, on the basis of 1929 production.

■

Third Empire Mining Congress; New Kleinfontein Closing

Johannesburg, March 26.—The third triennial Empire Mining and Metallurgical Congress opened at Cape Town on March 24. The Earl of Athlone, Governor General of the Union of South Africa, recalled the first copper exploration expeditions made in Namaqualand 250 years ago by Simon van der Stel, the first Governor of the Cape. In his presidential address, Sir Ernest Oppenheimer, chairman of Anglo-American, took a wide, inspiring view of the great mineral resources of southern Africa, calling them the best assurance of the maintenance of an enduring European civilization. He predicted a brilliant future for the copper mines of Northern Rhodesia.

. . . . At the same time as the opening of the Congress, the Transvaal Chamber of Mines held its annual meeting in Johannesburg. P. M. Anderson, a director of Union Corporation, who is chairman of the executive committee of the Congress, was elected president. J. Martin, a director of Central Mining & Investment, the retiring president, in an important address dwelt on the remarkable expansion of the mining industry of southern Africa during recent years. He declared that the chief need is freedom for further expansion, and stressed the importance of native labor to the industry.

. . . . New Kleinfontein has ceased operations. Several years have elapsed since this property, which is one of the oldest producing mines on the Far East Rand, has made any dividend distribution. It has a large tonnage of junore in sight, but present mining costs preclude continued operation. During 1929, 617,000 tons yielded £574,629, with an estimated working profit of £11,748. The threatened cessation of operations at New Kleinfontein had focussed wide attention on the problem of the future of the low-grade Rand mines, and a government commission was appointed recently to investigate the matter. The closing of this mine will cause considerable unemployment in the district, both of European and native labor. The town of Benoni depended largely on the mine and the mine force for its existence.

. . . . Discussions are in progress in Cape Town concerning the quotas of diamond production to be allotted to the government deposits, the big mines, and the alluvial workings. These discussions have been brought about by the accumulation of large stocks in the hands of the big producers, following government production from the recently discovered Alexander Bay deposits in Namaqualand. New Jagersfontein, one of the largest of the diamond-mining companies, has had to pass its interim dividend on common stock for the period ended March 31. In 1929, a dividend of 10 per cent was paid.

■

Interest at Congress Focussed on Rand's Mining Problems

Johannesburg, April 1.—The opening sessions of the third triennial Empire Mining Congress have been featured by discussion of the mining problems that face the great Witwatersrand district today. Last year the Rand produced 9,980,713 oz. of gold, or more than half the total world production of the precious metal. The tonnage of ore extracted reached a total of about 30,500,000. Continuation of this tremendous production is highly problematical, and the debates that centered on mine ventilation, mine hygiene, dust allaying, miners' phthisis, and mining at depths of 7,000 ft. or more, brought out many valuable suggestions as well as many conflicting viewpoints.

. . . . Several speakers expressed faith in Dr. J. S. Haldane's belief that miners' phthisis can be combated by introducing shale dust that would counteract the hard silica dust. Addition of water, which is today one of the principal methods used on the Rand in contending with miners' phthisis, is as dangerous to health as the dust menace it is designed to overcome, Dr. Haldane stated last year. Some leading scientists, on the other hand, although they would like to see Dr. Haldane's theory tested, pointed out that the risk of trying dry mining was extremely great. Results from this experiment could not begin to be known for six or seven years, as miners' phthisis usually takes that amount of time to develop. They feel, therefore, that application of the scheme on a large scale should not be entered upon without a great amount of information that is now lacking.

. . . . William W. Mein, director of International Nickel, and formerly manager or consulting engineer of many of the Rand mines, including Durban Roodeport and Robinson Deep, has returned after an absence of twenty years. He is greatly impressed with the possibilities of the Northern Rhodesian copper belt.

. . . . Honorary membership in the Institution of Mining and Metallurgy has been conferred on P. M. Anderson, the president of the Transvaal Chamber of Mines, for his great work in organizing and directing the preparatory work for the Congress. Mr. Anderson is chairman of the executive committee of the Congress.

. . . . New discoveries of radioactive pitchblende have been reported near Gordonia, Cape Province. With the advent of the dry season, preparations are under way for extensive development programs on the part of the Northern Rhodesian copper companies.

MARKET AND FINANCIAL NEWS

U. S. Zinc Industry Has Large Excess Capacity

S. D. STRAUSS

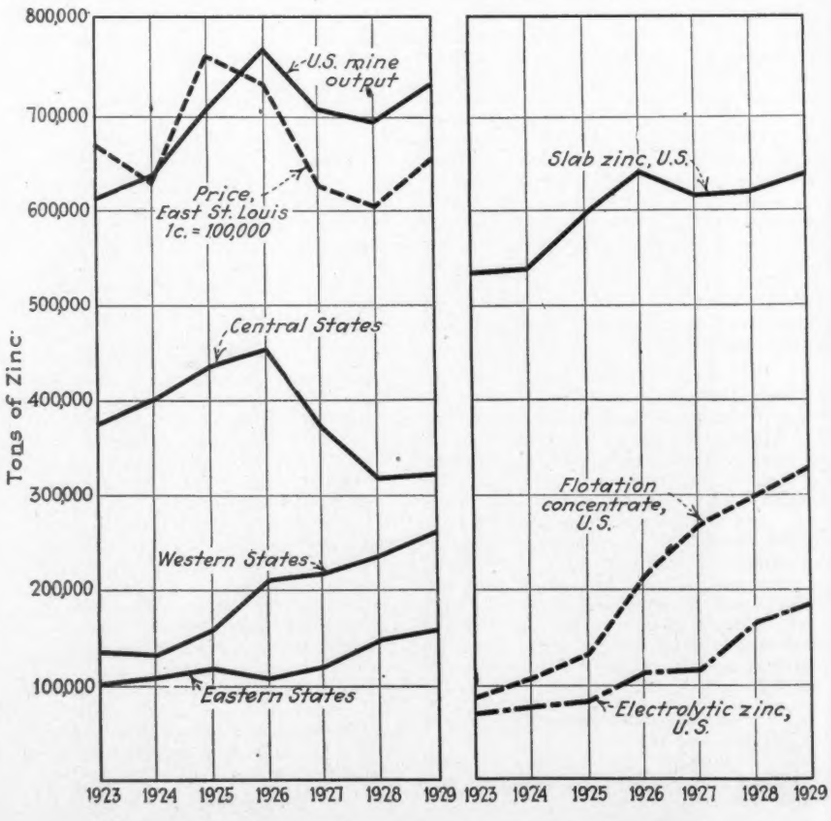
THAT a large number of new mines are being equipped for production was shown in an article published in the Feb. 24 issue of *Engineering and Mining Journal*. These properties, if present plans are carried to fruition, will add about 330,000 tons of zinc annually to the present world production within two or three years. The woes of the zinc market, however, are not caused by glimpses of a dismal future. The present reality is sufficiently disturbing. Technology has made advances that have led to the erection of new plants, although a surplus of old ones already existed.

The accompanying chart, which covers the period from 1923—the first normal year after the War—to 1929, indicates that the period of violent metamorphosis started by the discovery of selective flotation has not yet ended. A year or two ago the opinion was expressed that selective flotation had shot its bolt and that stability would return to the market. But the trend of supremacy in the zinc market continues to be toward the Western mines. Within four years the output from the Central states has declined 130,000 tons, or 29 per cent, while Western output has increased about 30 per cent and Eastern output—of relatively less importance—has increased 40 per cent. The decline in the Mississippi Valley has not been caused by depletion of reserves. If necessary, the mines in the Tri-State district probably could equal the record production of 1926. Low prices and voluntary curtailment are responsible for the loss. Less sensitive to price fluctuations because of their other products, Western zinc producers using selective flotation have increased their output steadily despite lower prices. The curve labeled "flotation concentrate" in the chart represents metal content of all flotation concentrates produced outside the Tri-State district and shows that about half the entire zinc output is derived from flotation products.

The expansion of electrolytic zinc production has not been quite so marked as the growth of selective flotation. At present four electrolytic plants are in operation in the United States. Output in 1929 was only about 50,000 tons less than their total capacity. No new plants are under construction, but at least two are planned—at Pend Oreille and United Verde. These would bring electrolytic capacity in the United States up to about 300,000 tons of slab zinc annually, or almost half the current rate of production. In comparison, reports of the American Zinc Institute show that barely half the retort capacity of the country is now in use. In 1929 the retort smelters produced about 450,000 tons of slab zinc. Capacity is about 700,000 tons. The total equipped capacity of the zinc industry in the United States, retort and electrolytic, is about 930,000 tons. Actual total production in 1929 was 630,000 tons of slab zinc. The increase in stocks amounted to 30,000 tons. Actually, therefore, industry absorbed 600,000 tons, or less than two-thirds of the zinc which our mines are prepared to produce.

Between 1923 and 1929, domestic zinc consumption has increased only 125,000 tons. At that rate, it will be 1945 before the present equipped capacity could be fully utilized. Because of the tariff wall, this country is practically self-contained as far as zinc production goes. In 1929, the exportable surplus was 10,000 tons. If our mines operated at capacity this figure could be vastly increased, but some of them would have to be content with receipts of 1½c. a pound less than they now obtain.

Apparent disparity between the U. S. mine output and slab output on the chart is explained by the use of large quantities of ore for lithopone.



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Financial Notes

SAN FRANCISCO MINES OF MEXICO, operating a lead-zinc property in Chihuahua, Mexico, made a net profit of £333,589 in the year ended Sept. 30, 1929, compared with profits of £283,130 in the previous year. Dividends paid during the same period totaled £286,285.

EAGLE-PICHER LEAD, operating lead-zinc mining properties in the Tri-State district, as well as manufacturing various lead products, reports a net income of $1,215,812 in 1929, after allowing for depreciation, depletion, and taxes. This compares with a profit of $1,151,177 in 1928. The balance on Dec. 31, 1929, was $1,167,537. Net sales of the company totaled $26,417,484. Dividends paid on common and preferred stock totaled $650,910.

Small Drop in 1929 Income of Phelps Dodge

Net profit of Phelps Dodge, operating copper mines in the Southwest and Mexico, showed a slight drop from $10,077,451 in 1928 to $9,601,212 in 1929. This profit is before depletion but after depreciation and taxes. Sales of copper were 151,217,364 lb., compared with production of 218,360,613 lb. At the end of the year the company had 76,400,327 lb. of copper on hand, compared with 10,356,978 lb. on hand at the end of 1928. Current assets of the company are $37,901,344, of which $14,086,156 represents metals on hand at the end of the year. Current liabilities are $5,659,646. The company's surplus on Dec. 31 was $67,841,464. Fixed assets were put at $204,271,133, against which a depreciation and depletion reserve of $119,424,927 had been accumulated.

■

American Zinc Profit Up

Profit from operations of American Zinc, Lead & Smelting increased from $861,157 in 1928 to $1,046,717 in 1929. At the end of the year the company's earned surplus was $1,264,504 after transfers to depletion and depreciation reserves and dividends on preferred stock. The company has current assets of $2,860,403, compared with current liabilities of $957,849. Accumulated unpaid preferred stock dividends on Nov. 1, 1929, amounted to $49.50 per share.

■

Slight Gain in Mohawk Profit

Operations of Mohawk Mining, copper property in Michigan, resulted in a net profit of $1,348,285 in 1929, compared with $1,284,737 in 1928. Cost of producing copper was reduced from 7.623c. per pound to 7.316c. per pound, but output dropped from 21,243,265 lb. to 20,043,127 lb. At the end of the year the company had current assets of $3,940,117, current liabilities of $107,726 and surplus of $2,653,136.

World Copper Production

Copper production of the world, from October 1929, to February 1930, inclusive, in short tons, according to the American Bureau of Metal Statistics, follows:

	Oct., 1929	Nov., 1929	Dec., 1929	Jan., 1930	Feb., 1930
United States	97,405	94,861	89,789	84,451	74,094
Mexico	4,986	4,872	5,227	5,067	4,657
Canada	7,268	7,291	8,009	8,053	6,750
Chile and Peru	31,152	27,007	27,226	23,967	21,120
Japan	7,802	8,004	7,719	7,272	6,362
Australia	357	1,409	1,720	124	1,546
Europe (a)	11,600	13,100	12,400	12,600	12,200
Africa	11,790	11,041	10,638	(c) 10,218	(c) 10,000
Elsewhere (b)	3,000	3,000	3,000	2,500	2,500
World's total	175,360	170,585	165,728	154,252	139,229

This summary is on the basis of fine copper content of blister, and in the main production is shown as reported by smelters without any attempt to segregate according to countries of origin.
(a) Incomplete. (b) Estimated. (c) Partly estimated.

Hecla Profits Up in 1929

An increase of almost $340,000 in operating profit, equivalent to about 18 per cent, is the feature of the annual report of Hecla Mining. Total income was $3,710,084 in 1929, compared with $3,471,394 in 1928 for a slightly larger output. Operating profit was $2,227,465, compared with $1,888,042, and the addition to surplus, after dividends, taxes, and depreciation, was $979,478, compared with $882,983 in 1928. The company's surplus is now $5,635,085. Statistics of interest follow:

	1928	1929
Dividends paid	$700,000	$900,000
Tons mined	312,942	310,753
Costs per ton	$5.035	$4.766
Lead produced, lb.	58,767,761	58,725,646
Silver, oz.	1,733,359	1,662,212

■

Financial Notes

WALKER MINING will pay its initial dividend of 7.5c. a share on April 25 to stockholders of record April 10. This dividend will total $131,250 and is the first since the company undertook development of its copper property in Plumas County, Calif., about twenty years ago. Production is now about 14,500,000 lb. of copper monthly.

VANADIUM CORPORATION OF AMERICA and subsidiary companies for the year ended Dec. 31, 1929, report net income of $1,849,886, after federal taxes, depreciation, depletion, and other charges, equivalent to $4.89 a share on 378,367 no-par shares of capital stock. This compares with $1,706,024, or $4.53 a share on 376,637 shares, in 1928.

CALIFORNIA-AHUMADA MINING, operating a silver-lead property at Los Lamentos, Chihuahua, Mexico, had current assets of $5,055 on Dec. 31, 1929, as compared with current liabilities of $18,899. During the year $99,593 was spent in development work on the property. Production was 1,560 tons of ore in 1929. In December the company made operating profit of $5,652.

BROKEN HILL SOUTH, operating a lead-zinc-silver property in New South Wales, has made an extra payment of 6d. per share in its February dividend, bringing total payment per share up to 2s., or £80,000. The extra dividend reflects increased profits in 1929.

ALASKA JUNEAU in February, 1930, mined and trammed to mill 298,440 tons, from which receipts were $255,500, or 85.61c. per ton; operating expenditures were $184,000, or 61.65c. per ton, and operating profit was $71,500, or 23.96c. per ton. Other expenditures and accrued charges totaled $11,600, leaving to surplus $59,900 for the month. Indebtedness was reduced by $48,023.05, leaving an unpaid balance of $830,000.

Current Statistics of Production and Stocks of Copper, Lead, and Zinc

Data from American Bureau of Metal Statistics, and American Zinc Institute

Figures Represent Short Tons

	1929											1930	
	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
COPPER—North and South America													
Production, refined, daily average	5,049	5,276	5,378	5,219	4,630	4,952	4,795	4,478	4,930	4,846	4,458	4,270	4,328
Domestic shipments	98,771	105,860	99,051	93,743	95,258	98,720	96,970	98,043	105,729	68,979	58,150	69,932	61,879
Foreign shipments	50,150	59,946	57,708	55,123	48,461	40,204	45,035	45,921	53,461	37,879	35,652	30,358	29,597
Stocks, blister and refined	296,298	295,309	311,003	332,641	334,621	337,199	346,050	348,270	343,187	385,111	436,726	473,219	497,912
LEAD—United States and Mexico													
Production, smelter, daily average	2,559	2,617	2,720	2,792	2,777	2,723	2,556	2,631	2,773	2,693	2,481	2,352	2,566
Production, U. S. mines, daily average	1,723	2,118	2,083	2,067	1,925	1,881	1,904	1,893	1,993	1,983	1,783	1,558	1,825
Imports into U. S. A.	9,551	8,383	7,115	6,944	9,412	12,572	12,493	8,515	6,251	4,452	7,731	9,918	.....
Stocks, smelter and refinery	160,597	158,149	156,888	162,255	173,612	173,549	175,641	168,707	167,192	161,671	151,586	149,308	.....
ZINC—United States													
Production, daily average	1,720	1,790	1,822	1,837	1,708	1,756	1,783	1,776 (a)	1,643 (a)	1,587 (a)	1,567	1,648	1,604
Domestic deliveries	51,057	56,267	56,558	56,614	47,973	46,570	50,610	46,287	47,184	41,636	34,378	40,442	42,154
Exports, ores and dross	165	483	308	358	266	537	173	211	247	122	89	20	6
Stocks	40,620	37,962	34,588	33,826	36,932	44,122	47,833	53,363	57,116	63,061	77,262	87,933	90,703
World Production Rate (Daily Average)													
Copper	5,968	6,219	6,561	6,213	5,820	5,629	5,595	5,805	5,657	5,636	5,346	4,976	4,972
Lead	5,068	5,176	5,418	5,440	5,467	5,277	5,200	5,301	5,494	5,463	5,168	5,015	5,271
Zinc	4,357	4,448	4,537	4,528	4,483	4,388	4,397	4,437	4,385	4,365	4,419	.....	.....

(a) Zinc produced in U. S. from Mexican ore not included.

Looks for Good Year in World Consumption of Copper

The copper situation at present is substantially as it has been during the last few months, according to F. H. Brownell, recently elected chairman of the board of directors of the American Smelting & Refining Company, who commented on the position of the metal at the annual meeting of his company held on March 31.

"World consumption of copper," he said, "has grown at the rate of 6 per cent a year for a considerable length of time. In 1926 world consumption was 1,572,000 metric tons, in 1927 it was 1,612,000 metric tons, in 1928 1,836,000 and in 1929 it is officially reported at over 2,000,000 metric tons. At present domestic consumption of copper is about 80 per cent of last year. I believe that the 1930 foreign consumption of copper will be as good as in 1929 and foreign consumption normally equals 40 per cent of the total world consumption. The Young plan adoption permits business expansion. Europe is expanding her electric power by either hydro-electrification or building power plants at coal mines.

"In the United States 60 per cent of the copper consumption is taken by electrification. Public utility companies have larger plans for 1930 than 1929. This consumption will be fully as good as 1929, but office building and general construction to date is at a much lower rate than in 1929. Construction as a whole in the United States in 1930 will probably be at least 80 per cent of last year.

"If world consumption is only 75 per cent of 1929 it will be over 1,500,000 metric tons or just about present rate of operation for the mines of the world.

"Large producers who sell their own copper, realizing the falling off in consumption, have reduced output the most. Small producers who sell on *Engineering and Mining Journal* quotations are producing more than ever. The scrap return is the largest in seven years."

Mr. Brownell saw little to fear in the African situation. Katanga alone is now producing on a large scale, and an important supply of copper from that part of the world is a prospect rather than an actuality. Northern Rhodesia may prove the largest producing area discovered since the mines in Arizona.

Mr. Brownell said. "It would take over four years before northern Rhodesian output of copper came to 500,000 tons a year. The African increase in output would be needed before it was available. This surely would be so if the expansion in world consumption during the next five years was comparable to the rate of the increase prevailing during the last four or five years."

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Consolidated M. & S. Earnings Decreased Slightly in 1929

After provision for development, depreciation, depletion, insurance, and employees' pensions, Consolidated Mining & Smelting, operating mining and metallurgical plants in Canada, made net profits of $10,129,340 in 1929, compared with $10,341,162 in 1928. Provision for development, depreciation, and depletion in 1929 was $4,153,471, as compared with only $2,994,691. At the end of the year, the company had reserves of $18,530,376, compared with $16,158,085 at the end of 1928; and a surplus of $13,493,459, compared with $13,247,852. Dividends paid totaled $6,373,750. Production of metals was 8,346,632 lb. of copper; 300,433,924 lb. of lead; 172,096,841 lb. of zinc; 773,976 lb. of cadmium; 7,362,164 oz. of silver; and 14,694 oz. of gold.

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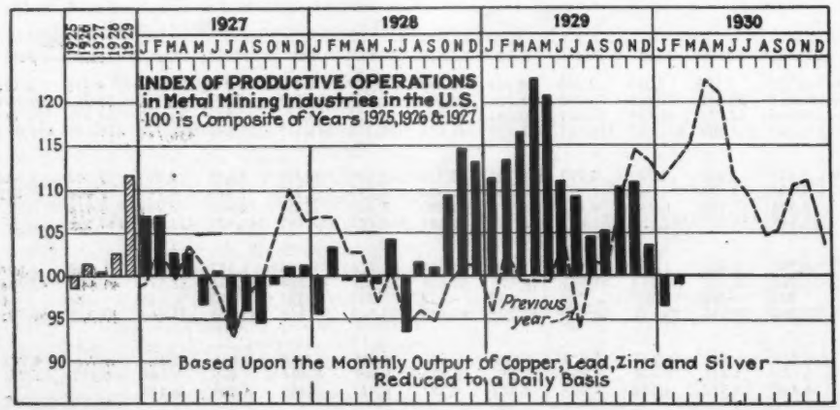
CALLAHAN ZINC-LEAD, operating in the Coeur d'Alene district, Idaho, reports a net loss of $76,097 in 1929, compared with a loss of $57,553 in 1928. Net value of concentrate produced was $98,799. The company had a net working capital of $323,782 at the end of 1929.

TAMARACK & CUSTER CONSOLIDATED, operating a lead property in the Coeur d'Alene district of Idaho, made a net loss of $6,450 in 1929. Revenue from ore sales was $558,915. The company has an earned surplus of $8,736, and current assets of $409,603.



World Lead Production Rate Higher in February

World output of lead during February amounted to 147,582 tons, which compares with 155,452 tons in January, and 141,895 tons in February of last year, according to the American Bureau of Metal Statistics. The daily rate of production, however, was up from that which obtained in the month previous, the figure for February being 5,271 tons, against 5,015 tons in January.

Production of lead in the United States was 51,114 tons, against 96,468 tons for the rest of the world.

Output of lead in December, 1929, and January and February of this year, in short tons, follows:

	Dec.	Jan.	Feb.
United States (a)	55,025	48,308	51,114
Canada (a)	13,529	15,595	11,689
Mexico (a)	21,847	23,172	20,531
Total North America (a)	90,401	87,075	83,334
Peru	1,586	1,581	1,575
Germany	11,277	11,022	10,793
Italy	2,594	2,453	1,384
Poland (c)	3,468	(d) 3,400	(d) 3,000
Spain and Tunis (b)	9,174	9,022	8,502
Australia	17,051	16,227	14,322
Burma	7,672	7,672	7,672
Elsewhere, estimated	17,000	17,000	17,000
World's total	160,223	155,452	147,582
United States	55,025	48,308	51,114
Rest of world	105,198	107,144	96,468

(a) Total North American production of crude lead is correctly stated, but the distribution by countries is not precise. So far as possible, pig lead produced in the United States from Canadian and Mexican ore is deducted and credited to its country of origin, but production from other foreign ores is not so segregated. (b) Partial. (c) Represents production of Polish Silesia. (d) Estimated.

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Financial Notes

SHERMAN LEAD, operating in the Coeur d'Alene district, Idaho, has declared an initial dividend of 1c. a share, paid in March, on 3,675,000 shares. During 1929 the company shipped 49,624 tons of ore, averaging 9.3 per cent lead, 2.5 per cent zinc, and 4.5 oz. of silver to the ton.

VENTURES, LTD., holding and exploration company operating chiefly in Canada, made a surplus of $174,936 from its incorporation in 1928 to the end of 1929. A total of $130,175 has been spent in development on properties which the company owns entirely. The value of the company's shareholdings in other companies, at cost, is $5,284,499.

SHATTUCK DENN MINING CORPORATION, operating two copper mines at Bisbee, Ariz., made a profit of $554,480 in 1929, compared with a loss of $95,879 in 1928. Net profit, after depreciation and depletion, was $124,237. Production amounted to 10,730,051 lb. of copper, at a net cost of 10.11c. a pound, from the Denn mine and 2,032,450 lb. of copper from the Shattuck mine. The Denn mine also produced 241,391 oz. of silver and 5,513 oz. of gold. In the last half year, costs at the Denn mine were reduced to 8.9c. per pound of copper produced.

Average Metal Prices for March, 1930

COPPER:	
Electrolytic, refinery	17.775
London Standard Spot	69.202
London Electrolytic Spot	83.405
LEAD:	
New York	5.662
St. Louis	5.542
London Spot	18.807
London Forward	18.940
SILVER:	
New York	41.654
London	19.298
Sterling Exchange	485.933
ZINC:	
St. Louis	4.934
London Spot	18.304
London Forward	18.810
TIN:	
Straits	36.798
London Standard Spot	164.851
QUICKSILVER	118.808
ANTIMONY	8.236
PLATINUM:	
Refined	54.769
Crude	46.769
ALUMINUM 99 Per Cent Plus	24.300

Financial Notes

PREMIER GOLD MINING, operating a silver-gold property at Stewart, B. C., made a net profit of $1,685,880 in 1929 before, and $459,575 after, depreciation, depletion, and taxes. Dividend payments for the year totaled $1,210,219. The company has current assets of $2,313,794, compared with current liabilities of $591,310. Production in 1929 was 98,442 oz. of gold and 2,429,751 oz. of silver from the treatment of 303,751 tons of ore. In 1928, production was 131,744 oz. of gold and 2,607,645 oz. of silver from 380,791 tons of ore.

ENGELS COPPER MINING, operating a copper property in Plumas County, Calif., made a net profit of $115,626 in 1929, before depletion but after depreciation and taxes. Gross value of production was $2,085,509 and came from 11,000,162 lb. of copper, 114,020 oz. of silver, and 1,798 oz. of gold. The company has current assets of $721,495 and current liabilities of $66,798. In 1928 the company operated at a loss of $54,435.

PORTLAND GOLD stockholders have been offered one share of United Gold Mines for every six shares of Portland Gold held. Both companies own gold mines in the Cripple Creek district, Colorado. Operations at Portland Gold were conducted at a loss of $88,334 in 1929, the third successive year to show a loss. Production was $467,755. United Gold Mines is a subsidiary of Golden Cycle Corporation, which operates the mill to which Portland Gold ore is shipped. Golden Cycle desires to prevent a possible shutdown at Portland.

Demand for Copper Improves—Good Trade In Lead—Zinc Steadies

New York, April 3, 1930.—Buying of copper and lead was in good volume, with higher prices for the latter. A moderate increase in the demand for zinc brought out a better feeling and slightly firmer quotations for this metal. In tin, the situation underwent little change, with business subnormal and prices still holding around the 37c. basis on rather liberal offerings from the East. Traders in silver were disposed to mark time, which was reflected in the action of the market, the price showing little change. Quicksilver was offered in a larger way, and lower prices were named in several directions. The weakness in platinum continues, the current price being the lowest since 1915.

Copper Sales Larger

Domestic sales of copper have shown a fair gain in the last two weeks, the volume of business booked comparing favorably with the average for 1929. The expansion in buying was attributed to the normal seasonal increase in business, and not to any change in the sales policy of consumers. Virtually all of the business placed was for what might be regarded as immediate shipment copper. One or two transactions did involve May shipment metal. Producers remain firm in their views, holding out for 18c., delivered in Connecticut, and 18⅛c. in the Middle West. The March statistics, to be announced in a few days, are expected to show another increase in stocks of refined. Sales for export during March were 34,600 long tons, against 33,000 tons in February. Copper Exporters continue to quote 18.30c., c.i.f. European ports.

Zinc Up from Low

After touching 4.80c. for Prime Western, prompt and near-by, the market for zinc took on a firmer tone, the result of a moderate gain in business. Toward the close sales took place at 4.85 to 4.90c., with several sellers not at all anxious for business at current levels. Efforts to revive the Cartel have not yet been abandoned by European producers. Estimated world production of zinc has shown no important decline since the first of the year, output remaining well in excess of current needs.

Silver Closes Lower

Silver prices moved up to 43⅛c. on March 22 on rumors that the Indian legislature had turned down the proposed duty, but this later proved to be a misinterpretation of cables. Prices have since eased off, closing at 41⅞c., with the undertone weak. The report of the commission of financial experts, headed by Edwin W. Kemmerer, recommending a gold basis for Chinese currency, was viewed with apprehension in silver circles. The commission, at the request of the Chinese government, has devised a plan for the reorganization of Chinese currencies.

Lead Active

In the last two weeks the price of lead advanced 25 points in the New York market, establishing the quotation at 5.75c., which was also the contract price of the American Smelting & Refining Company. The St. Louis price advanced 20 points during the period, closing at 5.60c. Improvement in the foreign situation was chiefly responsible for the higher market here, although heavy buying by large consumers added strength to the situation. Reports from London indicate that producers may come to some form of an agreement to curtail production. The daily rate of world production for February was 5,271 tons, against 5,015 tons in January.

Tin Unsettled

Domestic consumers of tin appear to be well covered against near-by requirements, for trading was quiet throughout the last two weeks. Efforts to bull the market in London met with little success, closing prices for spot Straits tin settling around 36⅞c. Deliveries in March totaled 12,200 long tons, compared with 8,963 in February, and 12,345 a year ago. Shipments totaled 11,591 long tons, against 13,512 in February, and 12,575 tons in March, 1929. The visible supply at the end of March was estimated at 32,972 long tons, an increase of more than 6,000 tons compared with a year ago.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c. London, 98 per cent, quoted at £95 per long ton, less 2 per cent for domestic consumption.

ANTIMONY—Per lb., duty paid: Chinese brands, spot, 8c.; futures, 5¾c., in bond. Cookson's "C" grade, spot, 13¼c. Chinese needle, lump, 8c. Standard powdered needle, 200 mesh, 10c.

BISMUTH—Per lb., in ton lots, $1.20. Smaller lots, $1.35 and up. London, 5s.

CADMIUM—Per lb., 80@85c. London, 3s. 11d.@4s. for prompt.

CHROMIUM—Per lb., 97@98 per cent grade, 95c.@$1.

COBALT—Per lb., f.o.b. Canadian works: Shot or rondelles, 97@98 per

Daily Prices of Metals

Mar. April	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
20	17.775	36.75	5.50	5.40	4.85@4.90
21	17.775	37.00	5.50	5.40@5.425	4.85@4.90
22	17.775	37.25	5.50	5.40@5.50	4.85@4.90
24	17.775	37.75	5.50	5.40@5.45	4.85@4.875
25	17.775	37.625	5.65	5.55	4.85@4.875
26	17.775	37.375	5.75	5.60	4.85@4.875
Av'ge	17.775	37.292	5.567	5.473	4.869
27	17.775	37.50	5.75	5.60	4.80@4.85
28	17.775	37.625	5.75	5.60	4.80@4.85
29	17.775	37.625	5.75	5.60	4.80@4.85
31	17.775	37.875	5.75	5.60	4.80@4.85
1	17.775	36.75	5.75	5.60	4.80@4.875
2	17.775	36.875	5.75	5.60	4.85@4.90
Av'ge	17.775	37.375	5.750	5.600	4.835

Average prices for calendar week ended March 22, 1930, are: Copper 17.775c.; Straits tin, 36.458c.; New York lead, 5.500c.; St. Louis lead, 5.415c.; zinc, 4.896c.; and silver, 42.396c.

Average prices for calendar week ended March 29, 1930, are: Copper, 17.775c.; Straits tin, 37.583c.; New York lead, 5.692c.; St. Louis lead, 5.563c.; zinc, 4.844c.; and silver, 42.375c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices of refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms or wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. The contract price for High-Grade zinc delivered in the East is 1c. above the St. Louis price for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

Silver, Gold, and Sterling Exchange

Mar.	Sterling Exchange "Checks"	Silver		Gold London	Mar. April	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
20	$4.85 3/4	42 3/4	20	84s10d	27	$4.86 1/4	42 1/2	19 5/8	84s11d
21	4.86 1/4	42 3/4	19 15/16	84s11d	28	4.86 5/16	42 1/4	19 1/2	84s11 1/4d
22	4.86 3/8	43 1/8	19 7/8	.....	29	4.86 5/16	41 7/8	19 7/16	.....
24	4.86 7/16	42 3/4	19 3/4	84s11d	31	4.86 1/4	42	19 7/16	84s11 1/4d
25	4.86 3/8	42 1/2	19 1/2	84s10d	1	4.86 3/16	42 1/8	19 7/16	84s10 1/2d
26	4.86 5/8	42 3/8	19 7/16	84s11d	2	4.86 1/8	41 7/8	19 3/8	84s10d

Average for the week ended March 26: Silver, 42.708c.; Sterling Exchange, $4.86344.

Average for the week ended April 2: Silver, 42.104c.; Sterling;Exchange, $4.86240.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis of 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter cent premium.

London

Mar. April	Copper Standard		Electrolytic	Tin		Lead		Zinc	
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
20	68 1/4	67 1/2	83 1/4	164 1/2	166 1/8	18 1/2	18 3/8	18 5/16	18 11/16
21	69 3/8	67 7/8	83 1/4	164 3/4	166 7/8	18 5/8	18 3/4	18 5/8	19
24	70 1/4	68 1/4	83 1/4	169 1/2	171 1/2	18 11/16	18 3/4	19 1/8	19 7/16
25	70 3/8	67 7/8	83 1/4	170	171 3/4	19	19	18 1/2	19 1/16
26	70 7/8	68 3/8	83 1/2	168 1/2	170	18 15/16	18 15/16	18 3/8	19 1/8
27	71 1/8	68 1/4	83 1/4	168 3/4	170	18 7/8	18 7/8	18 5/8	19 3/16
28	71 5/8	68 1/4	83 1/2	169 3/4	171 1/4	18 13/16	18 13/16	18 9/16	19 1/16
31	71	68 1/4	83 1/2	170 1/2	172 1/8	18 13/16	18 13/16	18 7/16	18 15/16
1	70 1/4	68 11/16	83 1/2	166 3/8	168 1/8	18 13/16	18 13/16	18 1/8	18 11/16
2	69 15/16	68 1/2	83 1/2	165 1/2	166 7/8	18 3/4	18 7/8	18 3/8	18 15/16

Prices for lead and zinc are the official prices for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

cent, $2.50. Contract sales booked at discounts, depending on quantity. Black oxide, 70 per cent, $2.10. London, nominal, 10s. for metal in small lots, 8s. for black oxide; 8s. 10d. for gray.

INDIUM—Per gram, $15.

IRIDIUM—Per oz., $160@$165 for 98@99 per cent sponge and powder. London, £32@£35.

LITHIUM—Per lb., 98@99 per cent grade in 100-lb. lots, $18.

MAGNESIUM — Per lb., 8-lb. ingots (3x3x15 or 16 in.), 65c.@$1, depending on quantity; 2½- or 3-lb. sticks (1⅛ in.), 90c.@$1.10, depending on quantity. London 3s. 3d.@3s. 6d. for 99 per cent ingots or sticks.

MOLYBDENUM—Per lb. in 50- to 100-lb. lots, 99 per cent, $11; 97 per cent, $9. (Usually sold as calcium molybdate or ferromolybdenum, which see.)

NICKEL—Per lb., ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.90 per cent), for single lots of spot metal. London, per long ton, £170@£175.

PALLADIUM—Per oz., $28@$30; London, £5 10s.@£6.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $48. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

QUICKSILVER—Per 76-lb. flask, $117. Market quiet and prices on round lots nominal. London steady, with offers at £22 15s.

TANTALUM — Per kilo: Rod and heavy sheet, chemically pure, $128; tantalum powder, c.p., $69.35.

■

Zinc and Lead Concentrate

Joplin, Mo., March 29, 1930

	Per Ton
Blende	
High	$40.46
Premium blende, 60%	37.00
Prime Western, 60%	$35.00@ 37.00
Flotation and table concentrates	35.00@ 36.00
Average settling price, all	37.61
Galena	
High	$68.90
Basis 80% lead	67.50
Average settling price, all	65.82

Platteville, Wis., March 29, 1930

Zinc Blende

Basis 60% zinc ..... $39.50 per ton

Concentrate

Basis 80% ..... $67.50 per ton

■

IRON CAP COPPER made a net profit, after depreciation, of $31,988 from its operations in 1929, as compared with $41,044 in 1928. Operations of its subsidiary, Mineral Products, which owns a feldspar mine in Tennessee, showed a lower income, which was partially offset by work at the Christmas Copper mine in Arizona. Because of heavy capital requirements at the Christmas property, however, dividends will probably be deferred until 1931. Production of copper was 4,417,770 lb. from the Christmas property in 1929.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York		London Spot		Sterling Exchange	
	1929	1930	1929	1930	1929	1930
January	57.019	45.000	26.257	20.896	484.577	486.447
February	56.210	43.193	25.904	20.008	484.787	485.784
March	56 346	41.654	26.000	19.298	484.776	485.933
April	55.668	.. ....	25.738	.....	484.808	.....
May	54.125	.....	25.084	.....	484.599	.....
June	52.415	.....	24.258	.....	484.330	.....
July	52.510	.....	24 289	.....	484.560	.....
August	52.579	.....	24 288	....	484.368	.....
September	51.042	.....	23.708	.....	484.253	.....
October	49 913	.....	23.042	.....	486.392	.....
November	49.615	.....	22 690	.....	487.104	.....
December	48.475	.....	22 258	.....	487.523	.....
Year	52.993	.....	24 460	.....	485.173	.....

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine. Sterling exchange in cents.

Copper

	New York		London Spot			
	Electrolytic		Standard		Electrolytic	
	1929	1930	1929	1930	1929	1930
January	16.603	17.775	75.551	71.469	78.602	83.250
February	17.727	17.775	78.228	71.419	83.538	83.500
March	21.257	17.775	89.153	69.202	98.356	83.405
April	19.500	.....	81.036	.....	89.405	.....
May	17.775	.....	75.026	.....	83.727	.....
June	17.775	.....	74.338	.....	84.013	.....
July	17.775	.....	72.152	.....	84.043	.....
August	17 775	.....	73.783	.....	84.250	.....
September	17.775	.....	75.286	.....	84.363	.....
October	17.775	.....	72 815	.....	83.978	.....
November	17.77[illegible]	.....	69.324	.....	82.202	.....
December	17.775	.....	68.303	.....	82.569	.....
Year	18.107	.....	75.416	.....	84.921	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1929	1930	1929	1930	1929 Spot	1929 3 Mos.	1930 Spot	1930 3 Mos.
January	6.650	6.250	6.498	6.100	22.111	22.344	21.545	21.571
February	6.853	6.236	6.739	6 086	23.128	23.156	21.188	21.097
March	7.450	5.662	7.348	5.542	25.409	25.591	18.807	18.940
April	7.187	.....	7.025	.....	24.783	24.408	.....	.....
May	7.000	.....	6.761	.....	23.949	23.750	.....	.....
June	7.000	.....	6.790	.....	23.694	23.603	.....	.....
July	6.804	.....	6.607	.....	22.810	22.880	.....	.....
August	6.750	.....	6.553	.....	23.185	23.259	.....	.....
September	6 890	.....	6.689	.....	23.557	23.589	.....	.....
October	6 873	.....	6.674	.....	23.226	23.253	.....	.....
November	6.285	.....	6.135	.....	21.622	21.643	.....	.....
December	6 250	.....	6.100	.....	21.472	21.484	.....	.....
Year	6.833	.....	6.660	.....	23.246	23.247	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London	
	1929	1930	1929	1930
	Straits		Spot	
January	49.139	38.851	222.727	175 466
February	49.347	38.676	223.138	173.750
March	48.870	36.798	220.781	164.851
April	45.858	.....	206.887	.....
May	43.904	.....	197.545	.....
June	44.240	.....	200.206	.....
July	46.281	.....	209.473	.....
August	46.619	.....	209.815	.....
September	45.359	.....	204.863	.....
October	42.290	.....	190.783	.....
November	40.208	.....	180.565	.....
December	39.745	.....	179.419	.....
Year	45.155	.....	203.850	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1929	1930	1929 Spot	1929 3 Mos.	1930 Spot	1930 3 Mos.
January	6.350	5.229	26.196	26.233	19.634	20.241
February	6.350	5.180	26.247	26.347	19.209	19.778
March	6.463	4.934	27.050	27.294	18.304	18.810
April	6.658	.....	26.759	26.613	.....	.....
May	6.618	.....	26.727	26.619	.....	.....
June	6 686	.....	26.216	25.984	.....	.....
July	6.766	.....	25.332	25.418	.....	.....
August	6.800	.....	24.896	25.164	.....	.....
September	6.799	.....	24.208	24.688	.....	.....
October	6.740	.....	22.927	23.329	.....	.....
November	6.242	.....	20.851	21.351	.....	.....
December	5.666	.....	20.072	20.672	.....	.....
Year	6.512	.....	24.790	24.976	.....	.....

St. Louis quotations, cents per pound. London pounds sterling per long ton.

Antimony, Quicksilver, and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)			
					Refined		Crude	
	New York		New York		New York			
	1929	1930	1929	1930	1929	1930	1929	1930
Jan.	9.558	8.606	119.481	121.192	70.000	61.923	60.000	51.923
Feb.	9.548	8.830	119.818	120.500	70.000	59.909	60.000	51.909
March	9.531	8.236	121.904	118 808	70.000	54.769	60.000	46.769
April	9.462	. . .	122.000	. . .	70.000	. . .	60.000	. . .
May	8.957	. . .	121.154	. . .	68.615	. . .	58.615	. . .
June	8.845	. . .	120.500	. . .	68.000	. . .	58.000	. . .
July	8.543	. . .	121.654	. . .	68.000	. . .	58.000	. . .
Aug.	8.778	. . .	125.111	. . .	68.000	. . .	58.000	. . .
Sept.	8 709	. . .	124.542	. . .	66.000	. . .	56.000	. . .
Oct.	8.538	. . .	124.298	. . .	65.000	. . .	55.000	. . .
Nov.	8 583	. . .	123.323	. . .	65.000	. . .	55.000	. . .
Dec.	8.420	. . .	121.950	.....	63.240	. . .	53.240	. . .
Year.	8 956	. ...	122.145	.....	67.655	. . .	57.655	. . .

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce. Price of crude based on pure platinum content.

Pig Iron[1] and Aluminum

	Bessemer		Basic		No. 2 Foundry		Aluminum	
	1929	1930	1929	1930	1929	1930	1929	1930
Jan.	18.00	19.00	17.50	18.50	17.50	18.50	24.300	24.300
Feb.	18.00	19.00	17.50	18 50	17.50	18.50	24.300	24.300
March	18.19	19.00	17.62	18 50	17.69	18 50	24.300	24.300
April	18.50	....	18.00	.....	18.00	.....	24.300	.....
May	18.81	.....	18.31	.....	18.31	.....	24.300	.....
June	19.00	. . .	18.50	. . .	18.50	....	24.300	. . .
July	19.00	. . .	18.50	. . .	18.50	. . .	24.300	. . .
Aug.	19.00	. . .	18 50	. . .	18.50	. . .	24.300	.....
Sept.	19 00	. . .	18.50	.....	18.50	. . .	24.300	.....
Oct.	19 00	.....	18 50	.....	18 50	. . .	24.300	. . .
Nov.	19 00	. . .	18.50	. . .	18.50	. . .	24.300	. . .
Dec.	19.00	.....	18 50	.....	18.50	.....	24.300	.....
Year.	18.71	.. ..	18.20	.....	18.21	....	24.300	.....

Iron in dollars per long ton. Aluminum in cents per pound, 99 per cent grade.

[1]F.o.b. Mahoning and Shenango valley furnaces; freight to Pittsburgh, $1.76.

Monthly Crude Copper Output in Short Tons

Domestic

	1929	1929			1930	1930
	Total	Oct.	Nov.	Dec.	Jan.	Feb.
Alaska shipments	21,947	1,203	2,079	2,275	1,219	1,298
Calumet & Arizona	65,246	5,206	4,981	5,132	4,591	3,665
Magma	19,118	1,660	1,338	1,377	1,168	1,068
Miami	29,569	3,350	2,882	2,609	2,807	2,564
Nevada Cons.	133,140	.....	.....	(d) 27,543	.....	.....
Old Dominion(a)	11,172	1,003	1,041	830	955	843
Phelps Dodge(b)	111,026	8,534	7,849	8,200	7,188	6,037
United Verde Extens.	29,669	3,019	2,388	2,371	2,223	1,869
Utah Copper	(c) 148,500	.....	.....	.....	.....	.....
Tennessee Copper	7,870	678	710	705	713	659

Foreign

Andes Copper	83,718	6,537	5,627	5,634	4,779	.....
Braden	88,155	7,523	6,768	6,766	4,519	.....
Boleo, Mexico	13,196	.....	.....	(d) 3,542	.....	.....
Bwana M'Kubwa	6,988	665	459	598	612	.....
Chile	150,247	10,873	8,746	8,743	7,492	.....
Furukawa, Japan	17,767	1,439	1,478	1,552	1,308	.....
Granby Cons., Canada	30,424	2,666	2,525	2,345	1,985	1,791
Howe Sound	.....	.....	.....	.....	.....	.....
Messina	(c) 7,200	590	519	588	641	.....
Mt. Lyell	7,600	790	773	624	734	.....
Sumitomo, Japan	20,180	1,785	1,719	1,612	.....	.....
Union Miniere, Africa	(c) 150,000	13,995	.....	.....	.....	.....

(a) Includes Arizona Commercial. (b) Moctezuma is included. (c) Estimated (d) Three months.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1928		1929		1930	
	Monthly Production	Daily Rate	Monthly Production	Daily Rate	Monthly Production	Daily Rate
January	68,469	2,209	86,324	2,785	67,838	2,188
February	67,423	2,352	84,735	3,026	59,547	2,127
March	70,327	2,269	93,698	3,023	.....	.....
April	69,721	2,324	94,902	3,163	.....	.....
May	73,729	2,378	93,392	3,013	.....	.....
June	73,224	2,441	82,354	2,745	.....	.....
July	73,426	2,369	79,229	2,556	.....	.....
August	76,952	2,482	78,885	2,545	.....	.....
September	78,341	2,611	79,402	2,647	.....	.....
October	86,480	2,790	82,575	2,664	.....	.....
November	85,382	2,846	75,934	2,531	.....	.....
December	85,677	2,764	74,772	2,412	.....	.....
Total	909,051	.....	1,006,203	.....	127,385	.....
Monthly average	75,754	.....	83,850	.....	.....	.....
Av. of daily rate	.....	2,484	.....	2,757	.....	2,159

Mining Stocks—Two Weeks Ended March 29, 1930

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Abana	Toronto	1.08	*89	*90	
Amulet	Toronto	1.50	1.44	1.47	
Anaconda Copper	New York	79	69¼	77⅜	Ap.12, My 19 Q 1.75
Andes Copper	New York	35⅜	31	35	Ap.12, My 12 Q 0.75
Arizona Commercial	Boston	1½	1⅜	1⅜	Ja. 16, Ja. 31 0.25
Calumet & Arizona	New York	86	77½	83	Mr. 7. Mr. 14 Q 1.50
Calumet & Hecla	New York	29⅛	26½	28	Fe.28, Mr. 31, Q 1.00
Cerro de Pasco	New York	64	57½	62½	Ja. 16, Fe. 1 Q 1.50
Con. Coppermines	N. Y. Curb	7¼	6½	7⅛	
Copper Range	Boston	15⅜	14½	15½	Mr.15 Ap. 25 Q 0.50
East Butte	Boston	1⅜	1⅛	1⅛	No. 20, De. 21 0.25
Granby Cons	New York	58⅜	52½	58	Ap.17, My.1 Q 2.00
Greene Cananea	New York	....	....	112	Mr.13, Ap. 7 Q 2.00
Howe Sound	New York	40½	35½	39⅜	Mr.31, Ap.15 Q 1.00
Hudson Bay	N. Y. Curb	13⅜	11⅜	13	
Inspiration	New York	29⅛	27⅜	28⅜	De. 19, Ja. 6 Q 1.00
Isle Royale	Boston	11½	10	10½	Fe. 28, Mr. 31 Q 0.50
Kennecott	New York	60⅜	54½	59	Mr. 14, Ap. 1 Q 1.25
Magma Copper	New York	52½	47	52⅜	Mr. 31, Ap.15 Q 1.25
Miami Copper	New York	31½	28⅛	31	Fe. 1, Fe. 15 Q 1.00
Mohawk	Boston	46½	45½	46½	Ja. 31, Mr. 1 1.50
Mother Lode	New York	2	1½	2	De. 9, De. 31 0.20
Nevada Cons	New York	29⅛	26⅛	29	Mr.13, Mr.31 Q 0.75
Noranda	N. Y. Curb	41⅜	39½	40	Mr. 15, Ap.1 Q 0.75
Ohio Copper	N. Y. Curb	1.00	*87½	*87½	Sept. 1926 0.03
Old Dominion	Boston	9	8½	8⅝	Dec. 1918 1.00
Phelps Dodge	New York	44⅜	37½	40⅜	Mr. 6, Ap. 1 Q 0.75
Quincy	Boston	38½	35	36	March, 1920 1.00
Roan Antelope	N. Y. Curb	28	25½	28	
St. Mary's M. L.	Boston	25½	23	24	Fe. 11, Fe. 25 2.00
Seneca Copper	New York	3	2½	3	
Shattuck Denn	N. Y. Curb	8½	7⅞	8½	
Sherritt-Gordon	Toronto	2.75	2.70	2.71	
Tenn. C. & C	New York	16½	14½	15⅝	Fe. 28, Mr. 15 Q 0.25
United Verde Ex	N. Y. Curb	16⅜	13½	15	Ap. 2, Ma. 1 Q 1.00
Utah Copper	New York	196	196	196	Mr.14,Mr.31 QX 4.00
Waite-Ack.-Mont	Toronto	5.00	4.80	4.90	
Walker Mining	Salt Lake	4.05	3.77½	4.05	Ap. 10, Ap. 25 0.07½
Wenden Copper	N. Y. Curb	*56½	*43½	*50	
LEAD, ZINC, SILVER					
Ahumada Lead	New York	1⅜	*75	1⅜	
Amer. Z., L. & S.	New York	14⅜	12⅜	13⅜	May, 1917 1.00
Amer. Z., L. & S. pfd.	New York	70	66	70	Mr. 20, Ap. 1 Q 1.50
Base Metals	Toronto	3.50	3.15	3.15	
Bunker Hill & S	N. Y. Curb	....	....	69⅜	Mr.25,Ap.5 MX 0.50
Butte Cop. & Z.	New York	3⅜	3⅛	3⅜	De. 10, De. 25 0.50
Butte & Sup.	New York	3⅜	3⅜	3⅜	De. 13, De. 31 Q 0.50
Callahan Zn.-Ld.	New York	1⅜	1⅜	1⅜	De. 1920 0.50
Canam Metals	Toronto	*30	*29	*29	
Chief. Cons.	Salt Lake	1.22½	1.12½	1.20	Fe. 1, 1918 K 0.10
Coniagus	Toronto	1.25	1.00	1.00	
Cons. Ld. & Zn. "A"	St. Louis	5¼	4½	4½	Jan. 1930 Q 0.12½
Constitution	Spokane	*21	*15	*18	
Dayrock	Spokane	2.40	1.75	2.30	Je. 20, Je. 30 0.03
Dickens Consol	Spokane	....	....	2½	
Eagle-Picher	Cincinnati	12⅜	11½	11⅞	Mr31, Ap. 15 Q 0.20
Eagle-Picher, pfd.	Cincinnati	....	....	101	Mr31, Ap. 15 Q 1.50
Eureka Bullion	Salt Lake	36	27	36	
Eureka Lily	Salt Lake	....	....	*33	
Evans-Wallower	N. Y. Curb	5	4⅜	4⅜	
Federal M. & S.	New York	185	174½	185	June, 1927 10.00
Fed. M. & S., pfd.	New York	100½	100½	100½	Fe. 17, Ma. 17, Q 1.75
Goldconda	Spokane	*74½	*56	*73½	Je. 15, Jl. 1, 0.02
Grandview	Spokane	*10	*8½	*9½	
Hecla Mining	N. Y. Curb	13⅜	11⅞	13⅜	Fe. 15, Mr. 15 Q 0.25
Highland-Surprise	Spokane	....	....	*6	
Jack Waite	Spokane	*10⅛	*8½	*10	
Kootenay Florence	Spokane	*3½	*2	*2½	
Lucky Jim	Spokane	....	....	*5	
Mexican Premier	Spokane	*80	*65	*79	Ja. 5, Ja. 15, 0.01
National Lead	New York	180	170½	174	Mr.14, Mr.31 QX 4.25
Natl. Lead, pfd. A	New York	142	140½	141	Fe. 28, Mr. 15 Q 1.75
Natl. Lead, pfd. B	New York	118	116	116½	Ap. 18, My.1 Q 1.50
N. J. Zinc, new	N. Y. Curb	91½	87	89⅜	Ap.19, My 10 Q 0.50
New Quincy	Salt Lake	*58	*43½	*58	Se. 20, Se. 30 Q 0.10
Noble Five	Spokane	*12½	*11½	*12	
North Lily	Salt Lake	2.25	2.20	2.20	Ja. 16, Ja. 23, Q 0.15
Park Bingham	Salt Lake	9	6½	6½	
Park City Con	Salt Lake	*38	*36	*36	
Park Utah	New York	3½	2½	3	Dividends suspended
Pend Oreille	Spokane	2.90	2.50	2.65	
Rico Argentine	Salt Lake	9	7½	9	No. 30, De. 15 Q 0.03
Ruth-Hope	Spokane	....	....	*14	
St. Joseph Lead	New York	56¼	49⅜	53⅛	Je .9, Je. 20 QX 0.75
Sherman Lead	Spokane	*68	*52½	*64	Mr. 20, Mr. 31 0.01
Silver King Coa	Salt Lake	10.37½	9.50	10.25	Mr. 20, Ap. 1 Q 0.25
Silversmith	Spokane	....	....	*5	Oct., 1926 0.02
Sunshine Mining	Spokane	3.75	3.25	3.65	De. 10, De. 20 Q 0.08
Tamarack-Custer	Spokane	*53	*36	*48½	Sept., 1924 0.25
Tintic Stadard	Salt Lake	8.25	7.50	8.25	Mr.18, Mr.29 QX 0.30
Treadwell-Yukon	Toronto	....	....	6.00	
Utah Apex	Boston	3⅛	2⅞	3⅛	Oc. 15, No. 1 0.25
Utah Met. & Tun	Boston	*95	*51	*80	Dec., 1927 0.30
Whitewater	Spokane	....	....	*15	
GOLD					
Alaska Juneau	New York	8	7	7⅛	
Barry-Hollinger	Toronto	*22	*18½	*20½	
Central Manitoba	Toronto	*16	*15	*15	
Cresson Consol	N. Y. Curb	*37½	*37½	*37½	Mr. 31, Ap. 10 Q 0.02
Dome Mines	New York	9⅛	8⅞	9	Mr 31, Ap 21 Q 0.25
Golden Cycle	Col. Springs	†16.00	†15.50	...	Fe. 28, Mr. 10 Q 0.40
Hollinger	Toronto	5.75	5.60	5.75	Ap. 8, Ap .22 M 0.05
Homestake	New York	79	77	77	Mr.20, Mr.25 M 0.50
Howey Mines	Toronto	86	80	81	
Kirkland Lake	Toronto	*78	*68	*70	
Lake Shore	Toronto	22.70	22.50	22.65	Mr. 1, Mr. 15, Q 0.30
McIntyre Porcupine	New York	18⅛	18	18⅛	Fe. 1, Mr. 1 Q 0.25
Portland	Col. Springs	†*3	†*1½	....	April, 1927 0.01
Rand Mines	New York	....	....	36	Fe. 21, Fe. 28, A.s. 1.52
Siscoe	Toronto	*40	*36	*39	
Sylvanite	Toronto	*75	*56	*60	
Teck-Hughes	Toronto	6.25	6.20	6.25	Ja. 17, Fe. 1 Q 0.15
Tom Reed	Los Angeles	*92	*71	*75	Dec., 1926 0.02
Unity Gold	N. Y. Curb	*37½	*37½	*37½	
Vipond Consol	Toronto	*97	*91	*92	April, 1927 0.03
Wright-Hargreaves	Toronto	1.83	1.78	1.79	Oc. 16, No. 1 0.02½
GOLD AND SILVER					
Carnegie Metals	N. Y. Curb	7¼	6	7⅛	
Castle-Trethewey	Toronto	*20	*15½	*16	
Keeley	Toronto	*35	*31	*32	Mr. 15, 1928 0.04
Mining Corp	Toronto	2.95	2.75	2.80	De. 4, De. 19 0.12½
Montana-Mines Corp.	Spokane	....	....	*36½	
N. Y. & Hond. Ros	N. Y. Curb	12⅜	12	12⅛	Ja. 21, Fe. 1, QX 0.50
Nipissing	N. Y. Curb	1⅜	1⅜	1⅜	Mr. 31, Ap. 21 Q 0.07½
Premier Gold	N. Y. Curb	1⅛	*75	1	Mr. 12, Ap. 4 Q 0.06
Tonopah Exten	N. Y. Curb	....	....	*10	April, 1925 0.05
Tonopah Mining	N. Y. Curb	1⅛	1⅛	1⅛	Se. 30, Oc. 21 0.07½
United Eastern	N. Y. Curb	....	....	*25	
Yukon Gold	N. Y. Curb	*62½	*50	*50	June, 1918 0.02
IRON AND STEEL					
Bethlehem Steel	New York	107⅞	100⅜	106⅜	Ap. 18,My.15, Q 1.50
Beth. Steel, pfd, 7%	New York	134	131	132½	Mr. 22, Ap. 1 Q 1.75
Cleveland-Cliffs, pfd.	Cleveland	100	91½	96	Mr. 5, Mr. 15 Q 1.25
Colo. Fuel & Iron	New York	67⅞	56⅜	65½	Fe. 10, Fe. 25 Q 0.50
Great Northern Iron	New York	25⅜	22	23	Dec. 15 R 2.00
Inland Steel	New York	95	90½	92½	Fe. 14, Mr. 1 Q 1.00
Republic I. & S.	New York	77½	73	77⅜	Fe. 11, Mr. 1 Q 1.00
Republic I. & S. pfd.	New York	114⅜	111	114½	Mr. 12, Ap. 1 Q 1.75
Sloss-Sheffield S. & I.	New York	56½	41½	50	Mr. 11, Mr. 20 Q 1.50
Sloss-Sheff. S.&I., pfd.	New York	82	70	75	Mr.11, Ap. 1 Q 1.75
U. S. Steel	New York	194½	178⅜	193½	Fe. 27, Mr. 29 Q 1.75
U. S. Steel, pfd.	New York	146	144½	145½	Fe. 1, Fe. 27, Q 1.75
MISCELLANEOUS					
Aluminum Co. of Am.	N. Y. Curb	335½	315	335½	
Alum. Co. of Amer., pf.	N. Y. Curb	108	106	108	Ma. 15, Ap. 1, Q 1.50
American Metal	New York	49	44	47½	Fe. 19, Mr. 1, Q 0.75
Amer. Metal, pfd., 6%	New York	115⅛	115	115⅛	Fe. 19, Mr. 1, Q 1.50
Amer. Sm. & Ref.	New York	77⅞	70½	75	Ap.11, My.1 Q 1.00
Amer. Sm. & Ref., pfd.	New York	138	137½	137½	My.2, Je.2 Q 1.75
Ang. Ch. Nitrate	N. Y. Curb	28	20⅜	28	
Asbestos Corp.	Montreal	3⅜	3	3⅛	Jan., 1926 1.50
Asbestos Corp., pfd.	Montreal	15	14⅜	14⅜	De. 31, Ja. 15 Q 1.75
Consol. M. & S.	Montreal	258	223	245	De. 31, Ja. 15 X 6.25
Falconbridge Nickel	Toronto	4.70	4.60	4.65	
Federated Metals	N. Y. Curb	24	23	24	Mr.27, Ap. 7 QX 0.50
Freeport Texas	New York	49⅜	43½	48⅛	Ap.15, My.1 Q 1.00
Int. Nickel Can.	New York	43	38⅜	42	No. 30, De. 31 Q 0.25
Int. Nickel, pfd.	New York	118	118	118	Ap 1, My.1 Q 1.75
Mayflower Assoc.	N. Y. Curb	63⅜	62⅛	63⅜	Mr. 3, Mr. 15 Q 0.50
Newmont	N. Y. Curb	136⅜	124	135⅜	De. 27, Ja. 15 Q 1.00
Patino M. & E.	New York	27⅜	23½	27⅛	De. 7, De. 24 4s.
So. America G. & P.	N. Y. Curb	1¼	1⅛	1¼	
Texas Gulf Sulphur	New York	67⅛	59⅜	65½	De.2, De. 16 Q 1.00
U. S. Sm. R. & M.	New York	36⅛	29⅜	35½	Ap.3, Ap. 15 Q 0.87½
U. S. Sm. R. & M., pfd	New York	52½	51	51	Ap. 3, Ap.15 Q 0.87½
Vanadium Corp.	New York	124½	90⅜	109	Fe. 1, Fe. 15, Q 0.75
Vetures Ltd.	Toronto	1.85	1.76	1.82	

Toronto Standard Stock Exchange, Toronto, courtesy the Arthur E. Moysey Co. Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Standard Stock Exchange, Spokane, courtesy Pohlman Investment Company

*Cents per share. †Bid—asked range. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. R, Irregular. I Initial. R, Respumption. X, Extra. The first date given is that of the closing of the books; the second that of the payment of the dividend. A.s., American shares.

LONDON QUOTATIONS—ONE WEEK ENDING MARCH 18, 1930

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	12/6	12/6	12/6		
Alaska Treadwell ($25)	42/6	30/—	42/6	Nov., 1926	4 d.
Aramayo Mines (25 frs.)	33/9	33/9	33/9	Nov., 1929	5 c.
Burma Corpn. (10 rupees)	13/10½	12/9	13/7½	Feb., 1930	7 annas*
Bwana M'Kubwa (5s)	21/9	19/—	19/9		
Camp Bird (2s)	1/—	—/7d	1/—	April, 1928	16⅔ p.c.
El Oro (5s)	1/9	1/9	1/9	Nov., 1929	20⅔ p.c.
Frontino & Bolivia (£1)	6/6	6/3	6/3	Jan., 1929	3⅓ p.c.
Mexican Corpn. (10s)	7/10½	6/6	7/6	Oct., 1929	10 p.c.
Mexico Mines of El Oro (£1)	1/10½	—/6d	1/3	Dec., 1926	3⅓ p.c.*
Mount Isa (£1)	23/7½	21/10½	22/6		
N'Changa Copper Mining (£1)	58/1½	50/—	52/6		
Oroville Dredging (4s)	1/4½	1/4½	1/4½	Nov., 1928	31½ p.c.
Rhodesian Congo Border (£1)	295/—	271/3	277/6		
St. John del Rey (£1)	18/—	17/9	18/—	May. 1929	7½ p.c.
San Francisco Mines (10s)	23/6	20/6	22/9	Jan., 1930	22½ p.c.
Santa Gertrudis (£1)	9/3	8/—	9/—	Jan., 1930	7½ p.c.
Selukwe (2s. 6d.)	3/9	3/4½	3/9	April, 1917	6¼ p.c.
S. Amer. Copper (2s)	2/7½	2/3	2/6	Nov., 1917	75 p.c.
Tanganyika (£1)	38/9	36/10½	36/10½	July, 1929	7½ p.c.
Union Miniere du Haut-Katanga (Brussels)	8,500	8,175	8,175	April, 1929	300 fr. (‡)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian francs and free of taxation.